***UNDERSTANDING HUMAN CONSCIOUSNESS AND MENTAL FUNCTIONS: A LIFE-SCIENTIFIC PERSPECTIVE OF BRAHMAJNAANA***

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***Abstract***

*A biophysical and biochemical perspective of Brahmajnaana will be advanced by viewing Upanishads and related books as “Texts of Science on human mind”. A biological and cognitive science insight of Atman and Maya, the results of breathing process; constituting and responsible for human consciousness and mental functions will be developed. The Advaita and Dvaita phases of human mind, its cognitive and functional states will be discussed.*

*These mental activities will be modeled as brain-wave modulation and demodulation processes. The energy-forms and their transformations as ideas/moods/experiences/thoughts/feelings/utterances/knowing/perception/experience/mood; and a theory of human cognition and communication will be advanced.*

*The sameness of these and processes taking place and steps involved in human language acquisition and communication processes will be highlighted taking ideas from Sabdabrahma Siddhanta and Sphota Vaada, for which the basis is Brahmajnaana only.*

*In fine, a physiological psychological and neurological model of human consciousness and function of mind based on Indian spiritual thought will be derived and discussed using concepts from modern science and technology. The application of these derivations in the fields of physiological psychology, mind-machine modeling, natural language comprehension branch of artificial intelligence and neurology to model and imitate human mental functions will be hinted.*

*In the Proceedings of 4th National conference on VEDIC SCIENCE with theme of* ***"Ancient Indian Life science and related Technologies"*** *on  23rd, 24th, and 25th December 2011 atBangalore conducted by National Institute of Vedic Science (NIVS ) Bangalore / Mulabagil*

**Introduction:**

Human beings gain knowledge of the objective world through the five sensory organs. While the objects of perception are insentient, the mind is sentient and hence emotionally reacts to sensory perceptions in the form of likes and dislikes, joy and sorrow. Hence the mind is responsible for the troubles that beset human beings. The mind can be drastically changed to respond to the stimuli it receives through the techniques of yogic methods of enquiry.

 Cognitive science is the interdisciplinary study of how information is represented and transformed in the brain. It consists of multiple research disciplines, including psychology, artificial intelligence, philosophy, neuroscience, learning sciences, linguistics, anthropology, sociology and education. It spans many levels of analysis, from low-level learning and decision mechanisms to high-level logic and planning; from neural circuitry to modular brain organization.

 Cognitive sciences often rediscover philosophical analyses painstakingly. A better policy to understand and model human consciousness and mental functions would be first to learn what philosophy (Eastern or Western) teaches us about human consciousness and mind in this regard, and then move on to experimentation and model–building within the scope of positive sciences. The aim of this research is to present such a possibility of using Indian spiritual and philosophical insight to model and understand the form, structure and functions of human consciousness and mind, and to provide as well necessary hints to develop software which would model the tasks of mind. This paper advances and discusses the nature (material as well as inhere), structure and scheme of human cognition and communication as available in Indian spiritual and philosophical insight. The scheme of cognitive and communicative processes during language acquisition and communication processes is also given.

 The *Upanishads*, The *Bhagavadgita*, The *Shat Darsnas* and the like are replete with many expressions which deal with human faculties and mental processes which can be used to understand and model human cognitive processes(1-10). Indian spiritual wisdom contained in the Upanishads, *Advaitasiddhanta, Shat Darshanas* and similar texts is not necessarily theological but is also psychological and scientific The *Upanishads* are traditionally commented on as theological texts(1). But *Upanishads* are also texts of science of mind (2-9)..*Advaita* and *Dvaita* concepts can be successfully used to understand the theory of human mental processes (3-5).*Atmajnana*, the *Upanishadic*wisdom when interpreted from psychology and modern science point of view, yields a mine of information about phases of mind, states of mind and functions of mind (2-16). The physical structure of mind and a model and possible theory of human cognition and language learning and communication processes can be presented when the ideas from *Upanishadic*wisdom, *Advaita* thought, *Shat Darsanas* and*Sabdabrahma* theory are clubbed (6,7). As a continuation to this approach, *vivartanam*, the chief idea of *Advaita* thought about generation of *maya* from *Atman* and transformation of *maya* to form *idam* consisting of *jiva, prapancham, jagat* etc., and their modern scientific implications are presented from physics and electronics view and understanding.

*Saddarsanas* (*Nyaya, Vaiseshika, Samkhya, Yoga, PoorvaMeemamsa,* and*UttaraMeemaamsa* or (Vedanta) are distilled expressions of the Upanishads, the texts of Buddhism, the texts of Jainism and related ancient Indian spiritual and philosophical texts. And are evolutionary products in nature, in advancing, and improving, substantiating, opposing, inducting, deducting contemplating over earlier texts and are codifiers of Indian philosophical essence having implications and applications to cognitive science.

*Nyaya* provides rules for valid and agreed to means of cognition. *Vaiseshika* gives idea about the construction and constitution of cognition, description of cognition elements in terms of minute parts (*anu*). *Samkhya* provides identification of constituent elements of cognition, instruments cognition, types of cognition. Yoga provides understanding of cognition process and stalling and or control of cognition process. *PoorvaMeemaamsa* discusses about cognition process and language acquisition and communication theories. Vedanta or *uttarameemasa* gives more comprehensive treatment of cognizing and cognized elements, instruments of cognition, phases or conscious states of mind (Upanishads), seven cognitive states (*Gayatri Mantra*), five functional states (*VedantaPanchadasi*) during which various cognitions and cognition-created and related happenings.

*Vyakarana* gives idea of process of language acquisition and communication. This paper makes use of Vedanta, *advaita* philosophy and *SabdabrahmaSiddhanta* (*SphotaVada*) essentially and sources from*Saddarsanas* and other related texts from all Indian traditions and schools of thought – spiritual as well philosophical.

Ramabrahmam(2-16),has delineated*Upanishadic* insight and presented human consciousness as a physical entity and as non-dual (a*dvaita*) awareness representing and being the original or normal or natural or ground state of human mind as pure consciousness. Then the experience is bliss/peace/silence and self-consciousness is absorbed or got absorbed in pure consciousness. Consciousness is also experience when no cognitions or cognition-related experiences are in the awareness of mind. Experienced awareness is consciousness. Awareness of nothing within or without the body is consciousness. It is peace, bliss and silence. Mind is dual *(dvaita*) awareness. Knowing, perception, thinking, doing intellectual operations, discrimination, feelings, having moods, urges, intuitions, understanding, getting and having insight, experiences are functions of mind reflected as cognitions and communications through sense organs and action organs respectively in the four consciousness states of mind (see concept diagrams I and II).

 Cognition of objects is temporary. *Atman* or *Purusha* is the constituent cause (*samavaayikaarana*). And contact of atman with *manas* is the auxiliary cause (*asamavayeikarana*). The Self brings about cognitions when it is contact with *manas*.

Ancient Indian wisdom as revealed in the *Upanishads* has a lot to say about human consciousness and mental functions (1-16). The expressions of the *Upanishads*,when translated into the modern scientific terms will benefit the fields of physiological psychology; the natural language comprehension branch of artificial intelligence, and the modeling of human cognition, language communication and understanding processes (2-16).***A brain-wave modulation/demodulation model of human cognition, communication and language acquisition and communication process based on Upanishadic expressions and SabdabrahmaSiddhhanta is presented here.****Brahma Jnana* or *AtmaJnana* is the basis of both *Vedanta* and *SabdabrahmaSiddhanta*(12-20).

**Concept of mind as available in *Atma-* or *Brahma- Jnana/AdvaitaPhilosophy*:**

*Atman or Brahman* is *Sat-Chit-Ananda*

***Upanishad:*** *poornam****adaha****pooram****idam****poornatpootnamudachyate*

*poornasyapoornamaadayapoornamevaavasisshyate*

***Isaavaasyoopanishat:****Isaavaasyam****idam****sarvam* ***/****yatkim cha jagtyaam****jagat***

*tenatyaktenabhunjeethaah****/*** *maagrudhakasyavittdhanam*

***AdiSankara:*** *Brahma sat* ***jagat****mithyajivo brahma evanaapraha*

*What is present always (in dristi and responsible for formation of dristi) is Brahman and jagat (which is moving or transient) is adhyasa (veil), over sat (Brahman); and mithya (unreal or virtual);jiva (self-consciousness or egoistic state of mind as adhyasa over Brahman) is Brahman (pure consciousness or unoccupied awareness) Itself, not different or separate.*

*Atman* (*yasyagamanamsatatam tat atma*) and *maya* (*yayaasantampasyatisamaya*or *ya ma samaya*) together constitute and compose of human consciousness and are the ingredients that construct and operate human consciousness and human mental functions (8). *Maya* (reflection of *atmasakti* or *chit sakti* in *medha* as *chidaabhaasa*) as *tamas*(i) conceals the *atmachaitanayam*; (ii) falsely identifies the individual with self-consciousness and forms ego - which are also part of inner mental world (*jagat*) by forming veil (*adhyasa*); thus causes (iii)*moham* and makes one see and experience *jagat* as *sukti-rajata-bhranti*; or *rajju-sarpa-bhranti* as*avidya* and (iv) makes *vidya* disappear from awareness (*dristi*); and (v) is transient,transitory and illusory reflection of *sat*.

 Because of these five kinds of illusions caused by *maya*, all inner mental world and mental functions (*prapancham*or*jagat*or*viswam*and self-consciousness) therein transpose themselves on *Atman* as pictures are superimposed on the cinema screen. *Atman* is like the cinema screen here. These pictures (cognitions, cognition related experiences, senses, meanings and self-consciousness) appearing on *Atman*-screen do not and cannot separate themselves from the screen and require the screen for their appearance, cognition and sustenance.

 All this is termed as *mithya* till the mental awareness becomes pure-consciousness and once this Truth becomes the *dristi* (conscious awareness), all these cognition and ego related-appearances are termed not separate from *Atman* but as part and parcel of *Atman*. *Dristi*(conscious awareness) is important. Just as waves are not separate from the sea so are the appearances as *sristi* (mental cognitions and self-consciousness) are not separate from *Atman*.

**Inner mental world(*idam*) and mental functions (*jagat*):**

***Vedanta Panchadasi:*** *Asti bhaatipriyamnamamroopamchetiamsapanchakam*

*AAdyatrayam brahma roopamtatodwayam****jagat****roopam*

is a famous expression of *Vedanta Panchdasi* by *Vidyaranaya.* This *sloka* says that *prapancham* (also known as *viswam*) is made up of five ingredients: *asti (sat* aspect*), bhaati (chit* aspect*), priyam (ananda*aspect*)-*the aspects of *Brahman or Atman, namam* (name) and *roopam* (form or sight or*drusyam* or *vishaya*), the aspects of *prapancham* or *jagathi* or *jiva*. Addition or *tagging* of *namam* and *roopam* to *Atman* forms *prapancham*in *jada*(potential) form. *Prapancham* becomes *jagat*(kinetic/dynamic) when retrieved and appears in the *dristi*. These *namam*and *roopam* also consist of words and forms we cognize and learn while learning languages, disciplines and skills and all kinds of knowledge

 In *jagat*, *Atman* is in three parts as *asti* – the *sat* aspect; *bhaati* – the *chit* aspect and *priyam* – *anandam* aspect, together with the two parts *namam* (name) and *roopam* (form). *Namam* is given by language and form is what the *vishaya* looks like or cognized like. It must be noted here that *prapancham* is created within as sensed by sense organs through the *antahkaranamanas*. So obviously the smells (by nose), tastes (by tongue) and touches and feelings of hotness and coldness (through skin) are also part of *prapancham* in addition to sounds heard by ears and forms seen by eyes. This *prapancham* will be in*jada* (potential) form and becomes *jagat* as kinetic form when retrieved and perceived by *manas* forming thoughts/feelings etc., (See concept Diagrams I and II)

 Consciousness is non-dual (a*dvaita*) awareness. It is experience as bliss/peace/silence when self-consciousness is absorbed or got absorbed in pure consciousness. Consciousness is also experience when no cognitions or cognition-related experiences are in the awareness of mind. Experienced awareness is consciousness. Awareness of nothing within or without the body is consciousness. It is peace, bliss and silence. Mind is dual *(dvaita*) awareness. Knowing, perception, thinking, doing intellectual operations, discrimination, feelings, having moods, urges, intuitions, understanding, getting and having insight, experiences are functions of mind.

**Scheme of human mental acquisitions, functionsand communications:**

 While mind is functioning, there will be a differentiated perception of *knower-knowing-known* or *subject-verb-object*, which will be missing and absent when non-dual (*advaita*) awareness or pure consciousness becomes unoccupied awareness (2-16). Experiencing or understanding or getting insight of verb is state of experience and then *knower-known* or *subject-object* are not attached to the verb. Verb will be in a present continuous form or infinite form depending on it is absorption of information or understanding cognition or experiencing cognition or urge (to express or do) or intuition (result of perception or instinct took form or genetic knowledge expressed through hormones or like them) or sense or meanings of utterances received or to be expressed (12-16).

 We knowingly or unknowingly alternate between non-dual *(advaita*) and dual (*dvaita*) awareness while functioning mentally. Wakeful and dream conscious states of mind represent and account for the phase of mind when functioning and then we also are aware of and sense or perceive self-consciousness. Once mind ceases to function, we experience peace, bliss and silence within. If these are experienced our being aware them, the phase of mind then is known as wakeful sleep. If we are unaware, but are conscious of these, the phase of mind then is known as deep sleep. The phase of cessation of mental functions (also self-consciousness) is similar to zero in number system and vacuum in physical and biological sciences. Vacuum is inherent in matter and holds matter and is manifested when matter is missing or absent. Consciousness is awareness of mind when no mental functions are taking place. This idea is further elaborated.

 Simply put, according to *Upanishads*, human mental functions are the forward and backward transformations of *chidabhasa* or *maya or pranavam* - the carrier (in the sense of carrier radio wave in broadcasting and reception process) cognitive-energy pulse series,***modulated***by energies sensed through sense organs or the stored information as potential energies retrieved (as *vasanas* - object-experiences, which include meanings of utterances, first and then *jagat*[retrieved inner world by antahakaranas- *manas, buddhi, ahamkaaram, chittam*]] as feelings/thoughts/perceptions) and ***demodulated*** to give humans knowledge, experiences etc.The transformation of *maya*, reverse transformation of *maya* and cessation of transformation of *maya* - the *dvaita* and *advaita* conscious states respectively- taking place simultaneously, consecutively and alternately is the structure, form, function, state and essence of human consciousness, mental functions and cognitive processes [8].Most of present attemptsaim at modeling machine cognition as an isolated process which is the result of sensing (19). But if human mental processes are observed, it becomes obvious that human perception is but an intermediary process which transfers sensing into sense (understanding/experience) and sense into expression. Human cognitive process can be stated sequentially as follows: (1) *sensing:* through sense organs (knowing), (2) *perception* (thinking, reasoning, decision making, etc.,), (3) *understanding/experience*, (4) *purport*- meaningful experience or experienced meaning. Human mental process is generally held to be a combination and quick successive transformations of four modes i.e.,

 **I Speaker/Teacher:** (a) Purport/Awareness (Meaningful Experience or Experienced Meaning (b) Understanding/Experience (c) Perception/Thinking (d) Utterance /Expression

**II Knower/Listener/Learner:** (a) Knowing (through sense organs) (b) Perception/Thinking (c) Understanding/Experience (d) Purport (Meaningful Experience/Experienced Meaning)/Awareness.

Four conscious states of mind, which are phases (***jagrat,swapna, sushupti and jagratsushupti***), five functional states of mind (***annamaya, praanamaya, manomaya, vijnaanamaya and aanandamayakosas***) andseven cognitive states of mind: (***SaptaLokas – bhooh, bhuvaha, suvaha, mahaha, janaha, tapaha and satyam- Gayaatri Mantra***) (7) and four modes of language acquisition and communication are available.

**The scientific insight of above expressions – Brain wave modulation / demodulation model:**

 *Atman* provides pure consciousness and it is the human consciousness and has following structure: Human consciousness, in the form of and characterized by *Being-Pure Consciousness-Bliss* is:

i) an *Oscillating Energy-Presence* i.e., an infrasonic bio-mechanical oscillator, which is the result of breathing process and the subsequent rhythmic gaseous exchange in the lungs, issuing out mental energy pulses frequency of 10 Hz (a time-period of 10-1 sec) is the real source of mental energy, the *Being of Mind* and

ii) its reflected (in *medulla oblongata or reticular formation*)*virtual* energy-pulse series (*becoming of mind* – mental awareness) together constitute human consciousness and are the ingredients of human consciousness.

Human consciousness based on this proposition can be viewed as comprising of Pure Consciousness (*Being of Mind*) and Awareness (*becoming of mind*). *Atman* (mental or psychic energy source) takes care of the consciousness part and *maya*(reflected mental energy virtual form) and its forward and revere-transformations take care of the awareness part. Thus *Atman* is proposed to be an *infrasonic* mechanical oscillator giving out mental energy pulses of frequency 10 Hz (time-period of 10-1 sec.) 10 Hz is the frequency of this mechanical oscillator according to both western science and eastern philosophy and theory of language acquisition and communication.

**Brain Waves:**

The enormous number (300 million) and surface area (70 square meters) associated with alveoli constituting this bio-oscillator/.bio-maser produces enormous amount of mental energy though the frequency is in the infrasonic range. [It is interesting here to mention that the mental rhythms detected by the experiment by German scientist Hans Berger {Adian and Matthews, 1934)}using EEG (electro-encephalogram) also have the same time- period of 10-1 sec]. These are called brain waves.

 At any instant brain neurons are generating millions of nerve impulses (action potentials). Taken together these electrical signals are called brain waves. Brain waves generated by neurons close to the brain surface, mainly neurons in the cerebral cortex, can be detected by sensors called electrodes placed on the forehead and scalp. A record of such waves is called an electroencephalogram or EEG. Electroencephalograms are useful both in studying normal brain functions, such as changes that occur during sleep, and in diagnosing a variety of brain disorders, such epilepsy, tumors, trauma, hematomas, .metabolic abnormalities, sites of trauma, and degenerative diseases. The EEG is also utilized to determine if “life” is present, that is, to establish or confirm that brain death has occurred.

 ***Patterns of activation of brain neurons produce four types of brain waves and*Being and Becoming of mind.**

1. **Alpha Waves:** These rhythmic waves occur at a frequency of about 8—13 Hz. One hertz is one cycle per second. Alpha waves are present in the EEGs of nearly all normal individuals when they are awake and resting with their eyes closed. These waves disappear entirely during sleep. (**Wakeful Sleep / (*JagratSushupti***) Conscious state; also ***vishrantadristi***.
2. **Beta Waves:** The frequency of these waves is between 14 and 30 HZ. Beta waves generally appear when the nervous system is active—that is, during periods of sensory input and mental activity. (**Wakefulness/Awakened /(*Jagrat***) and **Dream (*Swapna*)**Conscious States/States of mental function the result of simultaneous onset of advaita and dvaita states of mind with ***bahirmukhadristi*** – awareness of without - tuned to physical world outside and ***antarmukhadristi***- awareness of within – mental impressions of external physical world as inner mental world –*idam* or *prapancham* –*jada* - passive – *jagat* – active mind).
3. **Theta Waves:** These waves have frequencies of 4-7 HZ. Theta waves normally occur in children, and adults experiencing emotional stress. They also occur in many disorders of the brain.
4. **Delta Waves:** The frequency of these waves is 1-5 Hz. Delta waves occur during deep sleep in adults (**Deep Sleep** – ***Sushupti***) Consciousness State, but they are normal in awake infants. When produced by an awake adult they indicate brain damage.

**The Process of sensation and responses – working of nervous system – brain, spinal cord and neurons:**

Three linked functions drive the nervous system. Firstly, sensory input is provided by millions of sensory receptors that monitor changes—called stimuli—taking place inside and outside the body. Secondly, a processing and integration center analyses, stores and collates sensory input and makes decisions about what actions should be taken. Thirdly, a motor output activates effectors—either muscles or glands—resulting in a response. So, for example, seeing a charging elephant (sensory input) means danger (processing and integration) so the leg muscles are activated (motor output) to effect an escape.

The process of sensation begins in a sensory receptor, which can either be a specialized cell or the dendrites of a sensory neuron. As previously noted, a given sensory receptor responds vigorously to one particular kind of stimulus, a change in the environment that can activate certain sensory receptors. A sensory receptor responds only weakly or not at all to other stimuli. This characteristic of sensory receptors is known as selectivity.

 For a sensation to arise, the following four events typically occur:

***Stimulation of the sensory receptor:*** An appropriate stimulus must occur within the sensory receptor’s receptive field, that is, the body region where stimulation produces a response.***–***Knowing through ***Jnaanendriyani*** – Sense organs.

***Transduction of the stimulus:*** A sensory receptor transduces (converts) energy in a stimulus into a graded potential. Graded potentials vary in amplitude (size), depending on the strength of the stimulus that causes them and are not propagated. Each type of sensory receptor exhibits selectivity. It can transduce only one kind of stimulus. For example, odorant molecules in the air stimulate olfactory (smell) receptors in the nose, which transducer the molecules’ chemical energy into electrical energy in the form of graded potential.

***Generation of nerve impulses:*** When a grades potential in a sensory neuron reaches threshold, it triggers one or more nerve impulses, which then propagate toward the CNS. Sensory neurons that conduct impulses from the PNS into the CNS are called *first-order neurons.*

***Integration of sensory input:*** A particular region of the CNS receives and integrates the sensory nerve impulses. Conscious sensations or perceptions are integrated in the cerebral cortex. You seem to see with your eyes, hear with your ears, and feel pain in injured part of your body, because sensory impulses from each part of the body arrive in a specific region of the cerebral cortex, which interprets the sensation as coming from the stimulated sensory receptors.

**Integrative functions of the cerebrum:**

 We turn now to a fascinating, though incompletely understood, function of the cerebrum: integration, the processing of sensory information by analyzing and storing it and making decisions for various responses. The *integrative functions* include cerebral activities such as sleep and wakefulness, learning and memory, and emotional responses through actions organs (***Karmendriyani***).

**Wakefulness and Sleep:**

Humans sleep and awaken in a 24-hour cycle called a *circadian rhythm* that is established by the supra-chias-matic nucleus of the hypothalamus. A person who is awake is in a state of readiness and is able to react consciously to various stimuli. EEG recordings show that the cerebral cortex is very active during wakefulness; fewer impulses arise during most stages of sleep.

 Because stimulation of some of its parts increases activity of the cerebral cortex, a portion of the reticular formation is known as the **reticular activating system (RAS)**. When this area is active many nerve impulses are transmitted to widespread areas of the cerebral cortex, both directly and via the thalamus. The effect is a generalized increase in cortical activity.

Arousal or awakening from sleep, also involves increased activity in the RAS.

For arousal to occur, the RAS must be stimulated. Many sensory stimuli can activate the RAS; painful stimuli detected by nociceptors, touch and pressure on the skin, movement of the limbs, bright light or the buzz of an alarm clock. Once the RAS is activated, the cerebral cortex is also activated and arousal occurs. The result is a state of wakefulness called consciousness.

**Sleep:**

Sleep is a state of altered consciousness or partial unconsciousness from which an individual can be aroused. Although it is essential, the exact functions of sleep are still unclear. Sleep deprivation impairs attention, learning, and performance. Normal sleep consists of two components: non-rapid eye movement (NREM) sleep and rapid eye movement (REM) sleep.

***Brahma Jnana – SabdabrahmaSiddhanta:***

*Vakyapadeeyam* text endorses all the above understanding of concept of mind and its functions and describes, discusses and proposesinsight relating to human language acquisition and communication. The following *sloka* from *Brahma Kanda* of *Vakyapadeeeyam* is the gist of what all is discussed above.

*anaadinidhanam brahma sabdatatvamyataksharam*

***vivartate****arthabhaavenaprakriyaa****jagato****yatah*

This *sloka* states *Brahmanityatvam* and *vivartanopadatvam* of*jagat* as meanings/senses (*artha*)/ urges/thoughts/feelings (bhava) /expressions/utterances-the *arthabhavenaprakriyaa*- from Brahman. *Sphota* is *upadanakarana* – material cause of *jagat*which is a restatement of all that is discussed, the *Advaita* insight of AdiSankara (*Upanishadic*Commentaries) and Vidyaranaya (*Vedanta Panchadasi*), in the earlier sections.

 All this can be scientifically stated that, *Atman*or *Brahman*is the result of breathing process (19-20).*Srestaprana,* (most possibly O2, and the consequent rhythmic gaseous exchange taking place in the lungs)) is given as the body ( *tanu* ) of *Atman* VasistaGanapathi Muni [19-20]. *Atman* is always in motion (*yasyagamanamsatatam tat atma* – which moves incessantly is *Atman*) and is the result of breathing process and in modern scientific terms can be termed as a bio-oscillator/bio-maser/bio-laser issuing out pulses of mental (*chit*) energy (8). A period 10-1 of a second, the time required to pronounce a short syllable like ‘**a**’ is put forward as the time- period of this oscillator {It is interesting here to mention that the mental rhythms detected by the experiment by German scientist Hans Berger [21]using EEG (electro-encephalogram) also have the same time- period of 10-1 sec}. Thus this insight proposes *Atman* or *Brahman* as a biomechanical oscillator of frequency in the infrasonic (< or = 10 Hz) range (8-16).

*Sphota* is thus synonymous with*pravanavam* and is the infrasonic form of sound energy pulses (frequency less than or equal to 10 Hz). This definition very well suits the traditional one that *sphota* is issued out, by *veechi-taranga*(air waves) *nyaya* or *kadamba-mukula* (*kadamba*-flower bud)*nyaya*. As is known the very term ‘*sphuta*’ means which is issued out. Further the silent nature of the*sphota* is both because it originates from silence (nature and physical form of *Brahman*-the infrasonic oscillator of frequency 10 Hz). *Sphota* is *praakrutadhvani* (primordial sound, the*pranavam*) which reversibly transforms itself to make humans conscious, cognitive and communicative through language. Thus *Sphota* is physically infrasonic sound form and is responsible for all human mental functions both materially (*upadanakarana*) and instrumentally (*nimittakarana*) (14).

 Also according to *Upanishads* knowledge is of two kinds- (i) that acquired through the combined operation of sense organs, action organs and inner mental tools in the awareness of *Atman*( *MaitraJnana* ) and (ii) that is inherent / genetic/hormonal (*VarunaJnana*) (7). All our acquisitions of knowledge come under *MaitraJnana* and the in-built senses (*iccha and arthasaktis*), urges, volitions, body and mental abilities, capabilities, nature etc., come under *VarunaJnana.* In both the kinds of acquiring and retrieving knowledge from without the body and within the body,*sphota* plays chief role.

**Theory of language acquisition and communication:**

*Vivartanam* is the type of change that*sphota* undergoes while *sristi* (creation of mental impressions or mental world during language acquisition and communication) takes place.When*sristi* is being created or is in the *dristi* (Conscious awareness), we are mentally functioning. When *sristi* is in the awareness a veil is formed on*dristi*and creates*adhyasa*. According to *Advaita* thought only two mental situations are available for humans in the consciousness of the *Atman*. The situations are *nidra* or *sristi. Nidra*corresponds to the *sushupti* state of consciousness or phase of mind. During this phase of mind, all mental functions cease to be in the awareness and *maya,* whose transformations these mental functions are, becomes *nirvishayasuddhavasanaapravaaham*. During this phase of mind *maya* does not bifurcate as *divyam (jnanasakti)* and *swaram (pranasakti*) as in *jagrat* and *swapna* conscious states and both sense and actions organs remain dormant and functionless (also see Concept diagrams I and II) (2-16). Thus*SabdabrahmaSiddhanta* based on *Upanishadic*and *Advaitic* insight provides four modes of language communication and reception process; *para*-- mode of awareness--;*pasyanti –*mode of verb or sense or mood--;*madhyama*-mode of sentence,-- and*vaikhari* –mode of utterance in sound form, which can be successfully used to understand human language acquisition, communication and usage processes (8),(12-18).

**Concept of *Bhakti* and *Vibhakti*:**

*Bhakti*defined *as*

*swaswaroopaanusandhanambhaktirityabhidhiyate*-tuning the mind to its origin and original form(*Upanishads*) or*chetovrittirupetyatisthatisadaasaabhaitirityuchyate*-the state in which the mind disengages itself from all *vrittis (Sivanandalahari)*- *antahakaranaparinamas* (*manasikagathi*)- reversible transformations of inner mental tools-*manas, buddhi, ahamkaram and chittam*- and attains *nivritti* state (*nirmalamanasikasthiti*) stays as that -is the normal or natural or ground –energy state of mind. This is the state of absence of mental functions - the two-way transformation of *maya*/*pranavam//sphota*and *antahkarana*(4-8)*.* This is the state of *Atman* or *Brahman as tatpara*or *tatparya*or *rasa.* In this state the *chidabhasa*orvirtual chit -energy *maya/pranavam/sphota* – does not transform into *antahkaranas* (no *vivartanam* takes place) and no *antahkaranaparinama* takes place. This state is also known as *suddhasattavaguna* state, which amounts to *nirguna* state. *Rajoguna (antahkarana* mode) or *Tamoguna (antahkaranamaparinama*-cognition of objective energy-form) cease be.Transformation of *maya/pranavam/sphota*, reverse transformation of *maya/pranavam/sphota* and cessation of transformation *maya/pranavam/sphota*-the *dvaita* and *advaita* conscious states respectively- taking place simultaneously, consecutively and alternately is the structure, form, function, state and essence of human cognitive, language acquisition and communication processes. All this is also embedded in the *Brahma Kanda* of *Vakyapadeeyam*.

According totheory proposed in the above expressions the human language communication process is a combination and quick successive forward and reversible transformations of four modes i.e.,

**I. Speaker/Teacher: Language communication:**

 (a) Pure Consciousness/Purport/Unoccupied Awareness (Meaningful Experience or Experienced Meaning- *para*)

(b) Understanding/ Experience/ Sense/ Mood/Volition/ Intuition (*pasyanti*)

(c) Perception/Thinking/Feeling (*madhyama*)

(d) Utterance /Expression (*vaikhari*)

 **II. Knower/ Listener/ Learner: Language learning/acquisition and understanding**:

 (a) Knowing (through sense organs)-*vaikhari*

(b) Perception/Thinking - *madhyama*

(c) Understanding/ Experience/Sense/mood/Volition/Intuition -*pasyanti*

(d) Pure Consciousness/Purport (Meaningful Experience/ Experienced Meaning)/Unoccupied Awareness- *para*.

 In this theory the*advaita* state - *JagratSushupti-* proposed by *Vedantin*s corresponds to *para* mode of language communication process.This is the *tatparya* (purport) or *rasa* (experienced meaning) state. This *tatparya* state is a state of awareness of experience of meanings. And in this awareness the untransformed *maya* is the flow of *suddhavasanas.Pasyanti* mode of language is the state of senses (of words/sentences) or *arthasthiti* or state of verb. The verb will be in a *present continuous* or *infinite* form without subject and object(5, 9, 12-15).

 When an object energy-form, the *tanmatra,*[objective energy forms- optical-light(eye), mechanical (ear) -sound chemical (nose and tongue), mechanical, thermal(skin) (Concept diagrams I and II) – a *vishaya*- ] is sensed through *antahkaranas*, this verb state becomes a state of sentence – *bhava* or thought. This state is known as*madhyama* mode of language -the *vibhakti* state of sentence or thought and is the modulated *sphota* (undergone*vivartanam*). This modulated energy- form gets transformed into sound energy through vocal chords’ movement and is expressed /uttered. This is the *vaikhari* mode of language. All this happens in the speaker/teacher.

 This uttered sound-energy (the *vaikhari* mode of language) is picked up by the ears (sense organs) of the listener/learner and becomes sentence in the *madhyama* mode- the modulated *sphota*mode in conjugation with the *antahkaranas*(inner mental tools). This sentence-energy form in *madhyama*mode is in *subject-verb-object* (the triad*-triputi*) form. This mode of language gets demodulated (reverse transformation of *sphota - the vivartanam* in the reverse direction) into meaning, resulting in understanding/experience in the *pasyanti* mode- to a verb (sense), in present continuous or infinite form, the subject and object being dissolved in the sense of uttered /expressed sound.. This, when meaningfully experienced in the awareness of*para* mode, is the purport or *rasa or tatparya* of the uttered word- Bliss, Being, Peace or Unoccupied Awareness , the normal or natural state of mind - *i.e,* the state of Self, *Atman or Brahman.*

Thus *chit*-energy pulses, being issued out by *Atman* ***(****Sat-Chit-Ananda****)*** and after getting reflected in the*medha* as virtual or *chit*- energy *(chidabhasa* or *maya*or*pranavam*or*sphota*) pulses , first get *modulated* from this *para / rasa / tatparya* state by cognizing stored energies in potential *(jada)* form–in the form of subject-object- free verbs/senses, experiences, intuitions, understandings, urges , volitions through the*antahkarnachittam* to be transformed in to the mode of *pasyanti;* then again gets transformed into subject-verb-object state, the *madhyama* mode - by simultaneously cognizing the object energy-forms –*vishayas,* stored as potential energy *(jada)* forms – as *idam*, *jagat* or*prapancham* through the *antahkarana, manas* in the awareness of within –*antarmukhadristi*- as*bhavas* or thoughts. Intellectual operations such as reasoning, decision making, take place in this awareness. When the *antahkarana, manas* is tuned to the object energy-forms (light-eye, sound-ear, chemical- tongue, nose and heat, mechanical-skin) through*jnanendriyas* –sense organs- then the awareness becomes *bahirmukhadristi*-awareness of without. This process (in expresser/teacher and the reverse of this process, (demodulation in listener/knower/learner) happen in human-beings while expressing/speaking or listening/learning- as transformation or reverse transformation respectively-together known as *vivartanam*- of*maya/sphota* and *antahkarnas* in conjugation with sense organs and action organs, *karmendriyas.*

The gist of all above expressions and discussions is:

**Consciousness (Being-*Sat*) Awareness (Becoming-*idam*)**

**Speaker:**Modulation-*purodhana*

*Brahman/Atman chidaabhaasa/maya/pranavamantahkarananikarmendreyani /jnaanendrayani*

Import experience/understanding/insight feeling/thought/perception actions/reactions/cognitions

*Vivartanam*-Reversible Becoming

*Bhakti sphota+icccha/arthasaktivibhakti/ jnnanasaktiucchaarana/kriyasakti*

*Para/tatpara/Tatparyapasyantimadhyamavaikhari*

Purport mood/ urge/sense/ verb sentence/ subject-verb-object sentence in sound form

  *tirodhana*- Demodulation**: Listener**

**Conclusions:**

*Chidaabhaasaa/ maya / pranavm/ Sphota*is an infrasonic form of energy issued out in *Bhakti/tatpara/tatparya* state of *Brahman* from *Brahman. Jagat* is tagging of*namam* and*roopam* to *sphota* and is modulated (in speaker)/demodulated (in listener) form of maya/*sphota*. *Maya/sphota* in conjugation of *icchasakti*and *arthasakti* (both are biochemical forms of energy and are genetic/inherent/hormonal to the organism i.e., human-beings) becomes *pasyanti* as verb form in present continuous or infinite form creating moods/senses/intuitions/volitions/urges bereft of subject and object and further becomes*madyama* into a sentence form in conjunction with*jnanasakti*, with subject and object tagged and gets transduced into sound form as *vaikhari* in conjunction with*kriyasakti* and is uttered. Both *jnanasakti*(electro-chemical form of energy) and *kriyasakti* (mechanical/sound form of energy) are biophysical forms of energy and are created by the combined operation of sense organs, action organs and inner mental tools (*anthakarranas*). In the organism human-being the hardware of this process is hormones, neurons and proteins which carry out the required energy-transitions and transformations through brain, spinal cord, nervous system which includes sense and action organs.

All these functions are reflected as the brain waves and the brain waves are frequency-modulated and demodulated giving raise to alpha and beta waves which reflect the human cognition and communication and language and acquisition processes.

 Penrose (24-28) opines that the brain activity responsible for conscious understanding must depend upon a *physics* that lies beyond computational simulations. He also says that consciousness and mental functions are not merely algorithmic and says that a robot functions at the expense of intuitive qualities (24-29). In the light of this and also our observation and experience, the *physics* behind human mental functions and language acquisition and communication processes is necessary to be understood and an attempt is made in this article for the same. *Sphota* is stated as infrasonic wave series and it is the real *sabda* and other modes of language are *its* forward and reverse becoming. So a physics and electronics insight provided here will be *complementary* and *supplementary* to mathematical and computational approaches in this field of research and understanding concerning theory of Sanskrit language and grammar.

 Thus functional structure of mind and its transformations while acquiring and communicating language, knowledge and skills will be better understood by physics and physicochemical theory of human cognitive functions and abilities. The software for all these is available in the Upanishads, *Advaita* Philosophy, *Gayatri Mantra*, *SabdabrahmaSiddhanta* and *sphotavada*. These expressions when translated into modern scientific terms making use of concepts available in physics and communication engineering, as is done in this presentation, will clarify and resolve conceptual difficulties regarding understanding and experience and provide flow-chart and gross energy transformation model which can automatically evolve into algorithms constituting the software for mind-machine models. The expressions, discussion and conclusions given here thus point out to the distinct and different nature of natural language comprehension to natural language processing. Natural language comprehension is biochemical and biophysical whereas natural language processing is more computational. Natural language comprehension process when understood will be useful in developing mind-machines which can mimic more human mental functions.

**CONCEPT DIAGRAM I**

**COMPARISION OF HUMAN COGNITION AND LANGUAGE ACQUISITION AND COMMUNICATION PROCESSES – *BRAIN WAVE MODULATION/DEMODULATION MODEL***

Unoccupied,

Awareness,

Bliss, Silence,

Peace,

Meaningful

Experience

**Real I State**

Sense organs

Cognitions

Stimuli

***YOGA Knowing knower-knowing-known***

Demodulation/Modulation

Perceptions

Self-consciousness

Thoughts /feelings around individual/ego

 **Human**

Demodulation/ Modulation Experience/Meanings of cognitions Understanding

Memory

**Cognition**

**Process**

 *JNAANAM*

Action organsResponses

 **I-sense**  I**- I-expression**

*SattvagunaRajoguna***I-thought***Tamoguna*

 ***SPHOTA +* VERB** ***VIBHAKTI (SPHOTA AS SENTENCE)***

 ***MAUNAM / BHAKTI / RASA***

Verb with

subject and object in respective tense

Sentence

*Madhyama*

*SUKSHMA*

Experienced

Meaning

Purport

*Rasa*

*Tatpara*

*Para*

*Tatparya*

**Utterance**

 Movement of

vocal chords

hearing

 Ear

*Vaikhari*

*STHULA*

Verb in infinite or present continuous form without subject and object-senses /

meanings

*Pasyanthi*

*KARANA*

**Human**

**Language**

**Acquisition and**

**Communication**

**Process**

*Pranavam/sphota + Icchasakti/Arthasakti + Jnaasakti + Kriyasakti*

 Volition /Urge knowing Expression

 Intuition/insight /understanding perception Action

 Mood/Sense/ Experience/meaning logic/reasoning Reaction

Biochemical/Genetic/ Inherent /HORMONAL Biophysical

*Experiences/Perceptions of* mind are the reverse process of generation of *bhavah / artha*(thought/feeling/sense/meaning/understanding/insight)

**CONCEPT DIAGRAM II**

 **MODES OF LANGUAGE ACQUISITION AND COMMUNICATION**

***ADVAITA PHASE*** ***DVAITA PHASE***

***BHAKTI*  AWARENESS**

 **CONSCIOUSNESS** ***VIBHAKTI***

 *Transformations of Pranavam/sphota*

*PasyanthiMadhyamaVaikhari*

***Para Sphota***Language Teaching/Communication**Modulation**

 ***Purodhana***

Import

Tatparya

Purport

Rasa

Experienced meaning

Volition

Mood

Sense

Intuition

Urge

Instinct

Intuition

Ear senses

Utterance

Eye and hand- writing

Vocal chords

Utterance

hand-Writing

Sense

Meaning

Sentence

Sense

Meaning

 Sentence

***Tirodhana*** Language acquisition/understanding

  **Demodulation**

**Note:***Vivartanam = purodhana - tirodhanayutavartanam*or *parivartanam* is Reversible Becoming of *sphota*, the infrasonic mental energy pulse series-facilitating human language acquisition and communication.

Language acquisition/communication is a combined operation of ear/vocal chords (pronunciation), Eye/hand (to see and write shapes of alphabet) in conjugation with cognitive states of mind and modes of language acquisition and communication.

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