

Yoga Meditation Science and Practice: Liberation from propensities, Healing of mind and body, Gateway to enlightenment; EEG characterization of meditative state and Meditation effectiveness index

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Abstract

Today, Yoga is the most in-demand field, for psychosomatic health and well-being, cosmic thinking and living values, promoting enlightenment and liberation of the mind from samskaras. This paper addresses how Meditation can provide Liberation from propensities, Healing of mind and body, and Gateway to enlightenment.

We first outline the Science paradigm of the Cosmological cycle, providing the basis of Meditation. The Cosmological Cycle involves (i) cosmic consciousness devolving into the cosmic mind, expressing the five fundamental factors to form the cosmology (or the universe), (ii) microvita converting matter into the primitive mind and life structures, (iii) the process of organic evolution from primitive life structures to simple plants and animals, and eventually to self-consciousness human beings. This enables us to understand how the physical universe develops from cosmic consciousness, how life develops and evolves from the primitive mind into higher mind states, and how human beings can develop higher consciousness by doing meditation.

What is fascinating is the personal out-of-body experiences of ‘Enlightenment’ of people under cardiac arrest in hospitals. They seem to pass through a tunnel and then emerge into intense bright light, where they feel joy, peace, and love so intense as to be almost palpable.

Meditation Science involves ideating on cosmic consciousness, for (i) liberation from propensities, (ii) healing of mind and body, and (iii) progressing to enlightenment.

1. We need to recognize that the Cosmic Mind is all-pervading around us here on this Earth. So, for our unit minds to expand and evolve, we need to ideate on the Cosmic Mind or Divine Entity. The Divine Entity can put divine energy (i) into our bodies, by which we can get psychosomatic wellness, and (ii) into our minds, by which we can become liberated from our psychic propensities, and can become enlightened.

2. The mind and the physical body are linked by subtle energy centers called the cakras. The cakras are associated with and control specific endocrine glands. In meditation, we can energize the cakras by ideating on cosmic consciousness at these cakras, using an appropriate (two-syllable) mantra (which synchronizes with breathing). This in turn energizes the associated endocrine glands to secrete hormones into the organs. In this way, the organ systems get affected

and cured of their ailments. For example, energizing the Anahata cakra can help to promote the healthy functioning of the heart, and energizing the Manipur cakra can help to cure diabetes.

Meditation Practice is explained with three lessons: Lesson 1 is Ishvara Pranidhana, meaning offering one's mental self to God (or Divine Entity) and making union with God. Lesson 2 is Pranayama, the science of Pranah (cosmic vital energy). Lesson 3 is Chakra Shodhana, literally meaning purification of the cakras.

1. Ishvara Pranidhana involves recognizing the presence of the Divine Entity around us, disassociation from the surroundings and then from the physical body feeling, by which one is only aware of the Divine Entity (or Cosmic Mind). This enables ideating on the Divine Entity by means of a mantra. By this process, over time one's mind gets cleared from its embedded impressions formed by one's actions and interactions, and gets liberated.

2. In Pranayama, the concept is that the Cosmic vital energy of *Brahma* is around you, to be taken into you. So as one inhales (with the first syllable of the *mantra*), one can visualize that the vital energy (pranah) is entering the body through a cakra, to replenish oneself physically, psychically, and spiritually. Then, as one exhales (with the second syllable of the *mantra*), one visualizes that the vital energy is now going out through the cakra after it has been utilized in the body. The pranah is replenished again during inhalation.

3. In Cakra Shodhana, the concept is that the *cakras* are imbibed with vrittis (embedded sentiments or propensities), which are potential seeds of *samskaras* formation. Hence, we need to 'purify' our 'defective' *cakras* by stimulating them (at their central point of *ksiti piitha*) with the 'sacred idea' and *bhave* of our *ista mantra*. These sacred ideas imposed on cakras are propagated through nadis to the body regions, by which the body gets consecrated and the whole being is elevated.

We have then provided the Physiological Characterization of the Meditative State by EEG, for showing its Therapeutic Value

1. Association of EEG waves with mental state: States of rest, sleep, and mental activity have been characterized through the frequency analysis of electroencephalographic (EEG) data. Electrical activity from the brain is displayed in the form of brainwaves on an EEG waveform. There are three predominant categories of brainwaves based on the level of activity. Beta waves (12 to 38 Hz) are predominant during the normal waking state when one is engaged in cognitive tasks of problem-solving or decision making. Alpha brainwaves (8 to 12 Hz) are dominant when the mind is quiet, and also during meditation. Theta brainwaves (3 to 8 Hz) occur in deep meditation, when the senses are withdrawn from the external world and focused on the internal mind.

2. In our study, for each subject the EEG was recorded for 15 minutes with the subject in a relaxed but mentally active state, with the eyes closed. Then, the subject was asked to 'meditate' and the non-meditator was asked to 'concentrate', and their EEG was recorded during this period, which normally lasted for 30 min. A recording of the post-meditative or post-concentration period was also taken for 15 minutes. Frequency spectral analysis of the EEG data was carried out to determine the percentage of waves corresponding to each frequency band, as histograms. It is seen that for a meditating subject, there is a pronounced shift to a lower frequency spectrum during meditation. However, when the non-meditating subject 'concentrated', there was no shift in the EEG frequency distribution. Then the effectiveness of meditation can be characterized in terms of (i) the decrease in the percentage of alpha waves (8

to 12 Hz) from before to after meditation, and (ii) increase in the percentage of theta waves (4 to 8 Hz) from before to after meditation.

The Climax of the paper is the formulation of the Meditation Effectiveness Index. We know that meditation can enable decrease of heart rate (HR). So let us say that we monitor the HR during meditation by means of a wearable device. Let HR_t be the heart rate at time t during meditation. Now let us plot **HR_t vs time**, and then simulate this data by means of this expression:

$$HR_t = HR_s t^{-k}, \text{ to determine the value of } k$$

We can then develop the expression for

$$\text{Meditation Effectiveness Index (MEFI)} = k [(HR_s - HR_f)/HR_s] (100)$$

Greater the value of k and MEFI, the more effective can be the meditation. So we can develop a wearable device that can determine MEFI for meditation subjects, to determine the effectiveness of their meditation. This will be the first such 'meditation effectiveness index' based device.

Key Words: Yoga, Cosmological Cycle, Cakras, Meditation, Ishvara Pranidhana, Pranayama, Cakra Shodhana, Enlightenment, EEG, Meditation Effective Index.

Interdiction:

I. Yoga connects the mind and cakras, endocrine and neurological systems, thereby influencing mental and physical health, and promoting well-being

Meditation involves energizing our mind with ideation on Consciousness, for psychosomatic health, wellbeing, neurological care, and spiritual development. The mind and brain are interrelated. Neurological disorders affect the mind, and psychic disorders affect our thinking and the brain. Yogapathy connects the mind and brain, and is associated with mind-brain development and medicine.

Linking the mind and the physical body (or the organ systems) are subtle psychic energy centers or cakras, which control our mental propensities and behavioral expressions as well as the body's organs through the endocrine glands. Both mental and physical health and behavioral response of the individual depend on the proper energy balance between the cakras, and thereby the functions of the endocrine and nervous systems. Disease is caused by an imbalance in this energy flow between the cakras, and

the dysfunctions of the endocrine and nervous systems. Meditation on the cakras affects the endocrine glands, especially the pineal and pituitary glands, and thereby the brain and the neurological system.

II. The Science paradigm of the Cosmological cycle, providing the basis of Meditation

As can be seen in **Figure 1**, the Cosmological Cycle involves (i) Cosmic Consciousness devolving into the cosmic mind, expressing the five fundamental factors to form the cosmology (or the universe), (ii) microvita converting matter into the primitive mind and life structures, (iii) the process of organic evolution from primitive life structures to simple plants and animals, and eventually to self-consciousness human beings. This enables us to understand how the physical universe develops from Cosmic Consciousness, how life develops and evolves from the primitive mind into higher mind states, and how human beings can develop higher consciousness by doing meditation [1, 2].

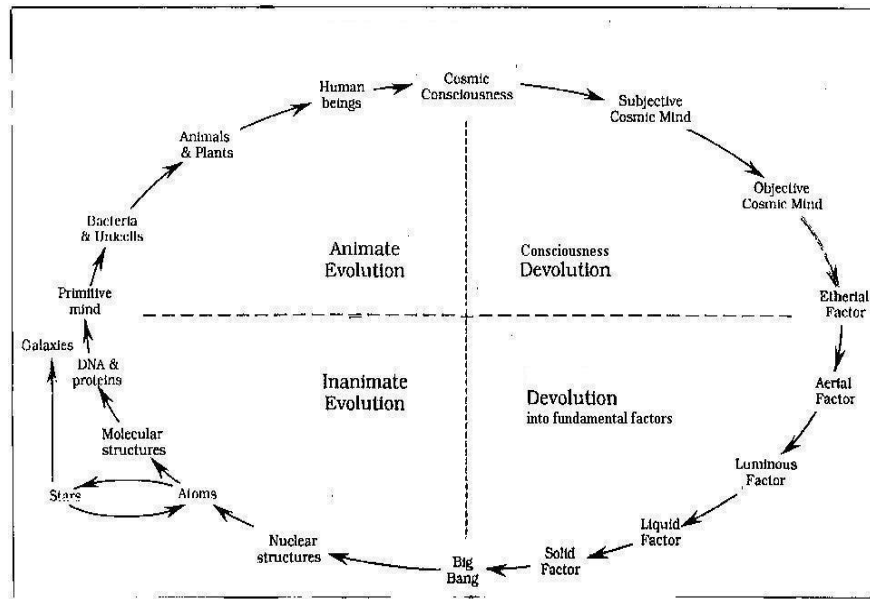


Figure 1. Cosmological cycle: (i) From Cosmic Consciousness to Cosmic Mind, to Big Bang and universe development, (ii) From the development of primitive life, to plants and animals, to human beings

Stages 1 and 2: As depicted in **Figure 1**, the Cosmic Consciousness first devolves into Cosmic Mind (Consciousness Devolution in Figure 1), and the Cosmic Mind devolves into matter (Devolution into five fundamental factors, in Figure 1). How? Through the Operative principle, the Cosmic Mind expresses itself into the five fundamental factors (etheral, aerial, luminous, liquid, and solid), providing the constituents of the physical universe and the basis of cosmology.

These 5 fundamental factors (5FFs) are associated with sensory properties called *tanmatras* [3], as shown in **Figure 2**. The subtler waves (of longer wavelength)

surround and pervade cruder waves (of shorter wavelength), but not vice versa. For example, the Ethereal Factor pervades all the other factors, but the Liquid Factor can only pervade the Solid Factor. These 5FFs are known to us through their sensory attributes. For example, the Ethereal factor carries the ‘sound’ sensory attribute, the origin of the primordial sound. The aerial factor carries the ‘sound’ and ‘touch’ attributes. The Luminous factor carries the sound, touch and light sensory attributes; the Liquid factor carries sound, touch and light attributes. The Solid Factor carries the sound, touch, light, taste, and smell attributes, as indicated in figure 2 [3].

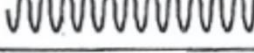
FUNDAMENTAL FACTORS	WAVEFORM	SENSORY PARTICLES
Ethereal		sound
Aerial		sound, touch
Luminous		sound, touch, sight
Liquid		sound, touch, sight, taste
Solid		sound, touch, sight, taste, smell

Figure 2: The dual wave-particle description of the physical world according to yogic science. There is a spectrum of wavelengths but discrete sensory boundaries.

As regards the relationship between this wave-particle description of the physical world and that of ‘new physics’, we can state that corresponding to these five FFs, there are five levels of structure in the new physics, as provided by **Figure 3** [3].

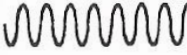
Yoga's Description			Physics' Description		
Fundamental factor	Waveform	Sensory Attributes	Particle Type	Particle Charges	Physical Structure
Ethereal		sound	vacuum state particles	?	space/time
Aerial		sound, touch	dark matter particles	flavour	galactic
Luminous		sound, touch, sight	?	?	stellar system & planets
Liquid		sound, touch, sight, taste	electron	flavour, electric	atomic
Solid		sound, touch, sight, taste, smell	quark	flavour, electric, colour	nuclear

Figure 3. A comparison of Yoga Science description of the physical world with that of Modern physics

All these five factors are formed by the pressure of the Operative principle (or Prakriti), referred to as *bala* [4]. As these factors get formed, they can also form structures which are (ii) invisible, containing only the ethereal, aerial, and luminous

factors, and (ii) visible if they contain all the five factors: ethereal, aerial, luminous, liquid, and solid factors. In Physics, the luminous invisible universe is referred to as dark matter and dark energy, which comprises 95% of the universe, while the

visible universe comprises 5 % of the universe. The luminous universes keep forming into the visible universes (during Stage 3 of Cosmological Cycle).

In this regard, let us refer to the near-death experiences (or NDEs) that are triggered during life-threatening episodes when persons under cardiac arrest in hospitals undergo such episodes. The survivors of close calls with death recount their experiences of consciousness leaving their body and rising upward, where they witness the resuscitation procedure going on below. They seem to pass through a tunnel and then emerge into a bright light. They say that in the bright light they feel comfort, joy, peace, and love so intense as to be almost palpable. Therein, they even perceive the spirits of deceased loved ones, departed relatives, and friends who seem to be there to welcome them [5]. Based on these recorded experiences, it is conceivable that our Earth is surrounded by a luminous

universe, to which people go to after their living on Earth. These experiences constitute enlightenment. Now this enlightenment experience can also be achieved by doing meditation resulting in 'samadhi'.

Now we have arrived at the beginning of Stage 4 in Figure 1, leading to mind formation. In the earlier stage of the Cosmological cycle, the Cosmic mind also emanates microvita, which now energize matter to form an ectoplasmic mind. Under the influence of microvita, matter evolves into subtler structures through synthetic reactions, thereby providing the templates of primitive life structures, represented by primitive states of mind (and consciousness), as illustrated in Figure 4. The positive feedback keeps the forward reaction going, causing more and more development of ectoplasmic mind material [1, 2].

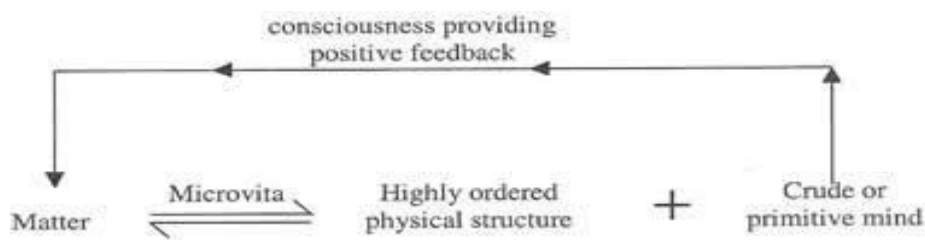


Figure 4. Emergence of a primitive mind and life-structure, through energization of matter by microvita

Stage 4: From this point onwards, the process of organic evolution begins and constitutes the **fourth stage (Animate Evolution in Figure 1)**, whereby primitive unicells and bacteria give rise to simple plants and animals, and eventually to self-consciousness human beings. From primitive organisms to complex organisms, there is an unfolding of Consciousness due to the increasing reflection of cosmic

consciousness, with a corresponding increase in psychic dilation of the mind and concomitant increase in complexity of the nervous and anatomical structures. Increasing psychic dilation of a living being's unit mind leads to intellectual development, and eventually to parapsychic and intuitional development. The psychic dilation of the mind eventually culminates in its achieving mental liberation, from its

psychic propensities embedded in the subconscious mind, based on our interactions and thinking. Eventually, the human mind becomes subtle enough to merge into Consciousness—how, by doing meditation. [This experience can be referred to as ‘enlightenment’, and its description is given above.](#) Simply expressed, the Cosmological cycle is completed when human beings develop cosmic consciousness.

III. Meditation Science: Ideating on Consciousness, for Liberation from propensities, Healing of mind and body, Progressing to enlightenment

1. Ideating on the all-pervading Consciousness, for rejuvenation of mind and progressing to enlightenment

We need to recognize that the Cosmic Mind is all-pervading around us here on this Earth. So, for our unit minds to expand and evolve,

we need to ideate on the Cosmic Mind or Divine Entity.

The Cosmic Mind puts divine energy (i) into our bodies, by which we get psychosomatic wellness, and (ii) into our minds, by which we can become liberated from our psychic propensities, and can become enlightened. This can even be validated through auras, using Kirlian Photography [6].

Thus, by effacing old psychic impressions and preventing new psychic impressions on the mind, the attractive force of Consciousness is felt on the mind, which now starts moving centripetally in the ectoplasmic field of Consciousness, as schematically shown in **Figure 5**. [This provides transcendence to the mind, rejuvenates the mind, and constitutes the basis of psychic expansion \(or evolution\) of the mind, progressing to enlightenment.](#)

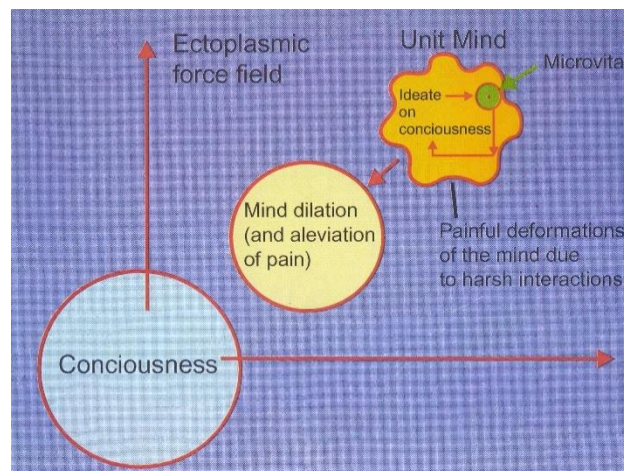


Figure 5. The Consciousness field and the location of mind in it. It is schematized that when a person (or her/his mind) ideates on Consciousness (by meditation), the mind dilates i.e., develops in ectoplasmic density. The mind keeps dilating until it merges into Consciousness, to attain enlightenment leading to *salvation* or *nirvana*

2. Energy Centers (or Chakras) linking the Mind and Body, and promoting Mind-Body Healing

As indicated earlier, the mind and the physical body are linked by subtle energy centers called the cakras. The cakras are associated with and control specific endocrine glands, as depicted in **Figure 6**.

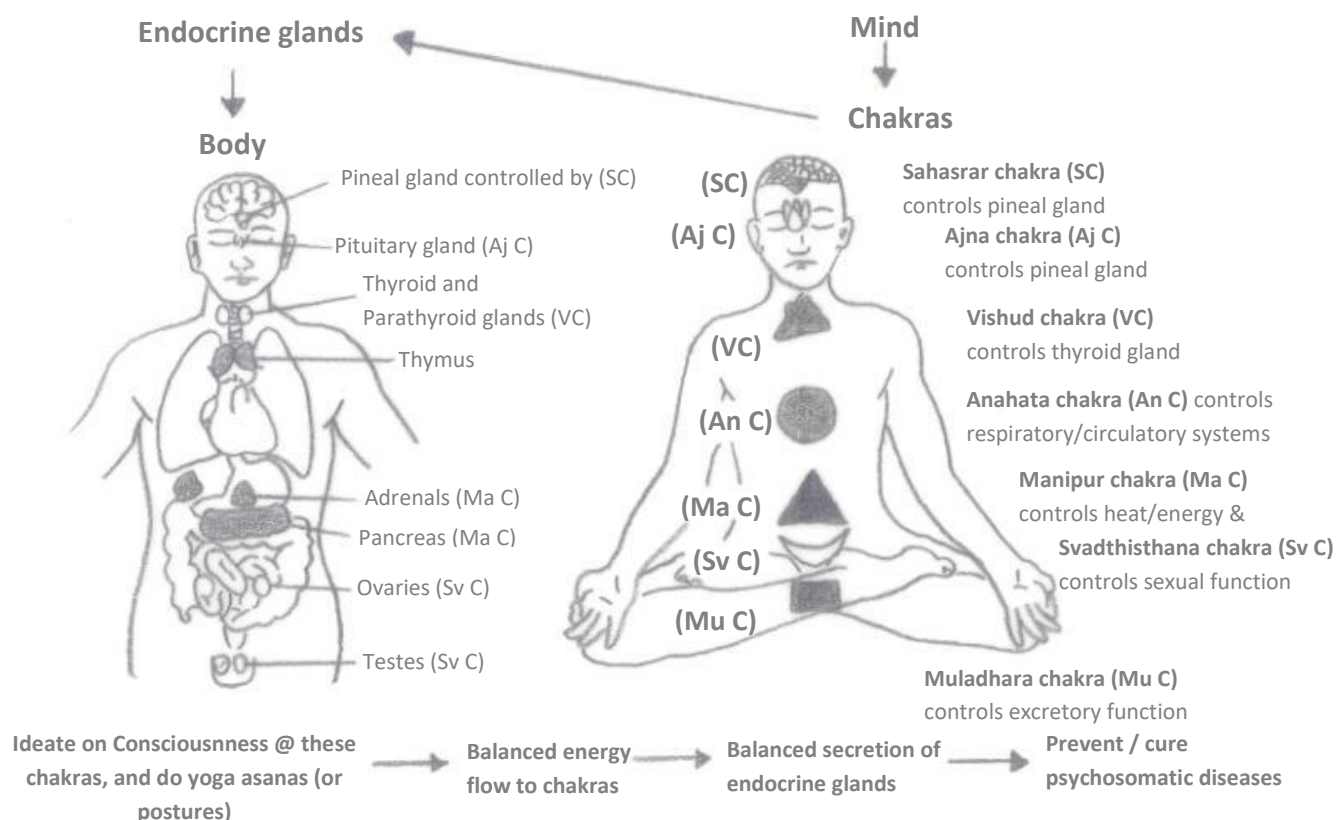


Figure 6. Chakras or Energy Centers and their association with the Endocrine Glands

The cakras regulate organ function through these glands, by stimulating their hormonal secretions; this is how the cakras influence the body. In the human mind, various thoughts are constantly emerging and dissolving. Behind these psychic phenomena are the underlying propensities (formed according to the past-psychic impressions on the mind). The propensities are expressed by the vibrational expression of the cakras, which in turn affect the endocrine glands through their hormonal secretions (**Figure 6**).

Both the expression as well as the control of these propensities is dependent upon the cakras. Emotional stresses (such as anxiety and insecurity) are known to be co-

responsible for diseases, such as coronary heart disease and even schizophrenia. In meditation, we can energize the cakras by ideating on Consciousness at these cakras, using an appropriate (two-syllable) mantra (which synchronizes with breathing). This in turn energizes the associated endocrine glands (as depicted in Figure 6) to secrete hormones into the organs. In this way, the organ systems get affected and cured of their ailments. For example, energizing the Anahata cakra can help to promote the healthy functioning of the heart, and energizing the Manipur cakra can help to cure diabetes.

IV. Fundamentals of Meditation Practice

1. Introduction

Our meditation practice involves the process of ideating on the Divine Entity by recognizing the divine presence around us. This brings in divine energy flowing into one's mind, flooding it with blissful feelings and literally lighting it up. This gives one immense happiness, based on the feeling of being taken care of by the Divine Entity. Through this process, over time one's mind gets cleared from its embedded impressions (or *samskaras*) formed by one's actions and reactions. This not only relieves stress but verily brings a peaceful feeling of 'oneness with Divinity', as enlightenment. In simple terms, meditation is taking the time off one's worldly involvements and spending time being with the Divine Entity, who is awaiting this union.

2. Goal of Meditation

The goal of meditation is total happiness through union (or yoga) of unit mind with Cosmic Consciousness or God. Meditation is taught in two forms: Group Meditation and Personalized Lessons. Group Meditation involves teaching the process of how to come in contact with and feel one with the Divine Entity or God, and thereby realize the feeling of extreme happiness and peace. Personalized Lessons involve initiation into the process of meditation, with the assignment of personalized Ista Cakra and Mantra. A spiritual seeker begins the path of self-realization by receiving initiation into the process of meditation. It is an important event in the life of a *sadhaka* (spiritual practitioner). One learns her or his personal technique of meditation, and thereby the latent spiritual potential is awakened. It is said that when the disciple is ready, the Guru appears. Meditation used to be taught directly by the Guru, but today for practical reasons it is taught by trained teachers called *acaryas*.

3. Our System of Meditation

Herein we will explain three lessons: **Lesson 1** is *Ishvara Pranidhana*, meaning offering one's mental self to God (or Divine Entity) and making union with God. **Lesson 2** is *Pranayama*, the science of *Pranah*. **Lesson 3** is *Chakra Shodhana*, literally meaning purification of the *cakras* [7, 8].

Lesson 1. Ishvara Pranidhana

The goal of this lesson is to obtain liberation from *samskaras* or embedded psychic impressions in the subconscious mind. Herein, the aspirant is taught how to ideate on and feel one with God or Divine Entity. This gives one immense happiness, based on the feeling of being taken care of by God. This is done by concentration on one's "I feeling" or Ista Cakra (mind center), and the use of a general mantra (or personal or "Ista mantra" given according to one's individual psychic vibration), to ideate on the Divine Entity. Three steps are required to reach this stage.

Meditation Steps:

Step 1 consists of recognizing and manifesting the presence of the Divine Entity around us in the form of mellow light. In this step, the meditator is only feeling the divine presence and is not aware of surrounding people or structures. This process of mind withdrawal from the surroundings is referred to as *bhuta suddhi*.

Step 2 involves developing a spirit body, to enable ideation on and union with the Divine Entity. In this step, by a special method, the mind or "I feeling" of the meditator is brought very carefully from (i) its disassociation with the external surroundings, and (ii) then from the physical body feeling, to where the "I" sits or the location of one's mind center. At this stage, one is only aware of oneself or one's mind and the Divine Entity (or Cosmic Mind)

surrounding it. *This process of mind withdrawal from body feeling is referred to as a'sana suddhi.*

Step 3 now involves the mind ideating on the Divine Entity using a 2-syllable mantra. The Mantra has a specific meaning and an acoustic sound. The general meaning of all mantras is “You are my Guide, and with your guidance, I can become divine”. This 2-syllable mantra is repeated mentally in consonance with one’s in-breath and out-breath. This brings divine energy flowing into one’s mind, flooding it with blissful feelings. At in-breath, the Divine Entity is infusing divinity into the mind. Then in response to this, at out-breath, one’s mind expands into divine Consciousness and even gets lit up, giving a feeling of being divine.

By this process over time, one’s mind gets cleared from its embedded impressions formed by one’s actions and interactions. Clearing the mind from its embedded impressions is referred to as **Liberation**. During this process of liberation, one’s entire mental thinking gets transformed, one’s personality and character get elevated, and one’s interactions with others enter a new phase. Over time, this brings a peaceful feeling of oneness with divinity known as enlightenment. This is verily the purport and goal of this meditation lesson.

Lesson 2. Pranayama

Concept: The Cosmic vital energy of *Brahma* is around you. You need to take it within you to keep you physically, psychically, and spiritually rejuvenated.

Psycho-philosophy: The cooperative activity of the ten vayus (five internal and five external) is known as pranah (vital energy), which functions as the direct cause of life and controls the activities of the body’s physiological structure. The

collective name of the ten vayus (vital airs or energies) is pranendriya. It is a “psychic organ”, which categorizes and analyzes perceptions received from the sense organs. Its position is in the middle point of *anahata cakra*.

Pranandriya plays the most vital part on the physical and psycho-physical levels. Every activity of pranendriya is pulsative, and it is during the state of pause and potentiality that the citta (consciousness) is able to take the form of incoming tanmatras (perception). If pranendriya is in a state of pause, it creates calmness throughout the psycho-physical structure, to assist the citta to perceive the tanmatras correctly.

This is the psycho-philosophy behind the practice of pranayama, entailing pranandriya to remain in a state of equipoise, thereby merging the unit mind into the ocean of Consciousness, to enable the experience of the supramental stratum.

When we concentrate and consciously regulate our breathing, we can store up a big amount of *pranah* in the various nerve centers or *cakras*. Through *pranayama*, every part of the body becomes filled with vital energy, and all diseases can be destroyed from the root.

Performing Pranayama: The practitioners are instructed to do *bhuta suddhi* and *a'sana suddhi* withdrawal phases, as explained in the First Lesson. Then, with the first syllable of *Ista mantra*), one visualizes that the Vital energy (pranah) is entering the body through the prescribed *cakra*. This vital energy is being used to replenish oneself physically, psychically, and spiritually. Then, as one exhales (with the second syllable of your *Ista mantra*), one visualizes that after the vital energy has been thus utilized, it is now going out through the *cakra*; after this, the

pranah is replenished again during inhalation.

Proper control of breathing can alleviate many diseases, such as heart disease, high blood pressure, asthma, and tuberculosis, among others. Breath control dissolves emotional tensions and relaxes the mind, and it also increases willpower, concentration, and self-control. Finally, if the Divine Entity's pranah is infused, one can get totally sanctified and one's ideas will be divine ideas.

Lesson 3. Cakra Shodhana (Cakra Purification)

Background: Cakras are sub-stations of the mind, as illustrated in **Figure 6**. The state of body and mind depend on the activeness of the cakras. By Cakra Shodhana, the mind and body get purified, and the whole being is elevated.

Concept: The *cakras* are imbibed with *vrittis* (embedded sentiments or propensities), which are potential seeds of *samskaras* formation. Hence, we need to 'purify' our 'defective' *cakras* by stimulating them (at their central point of *ksiti piitha*) with the 'sacred idea' and *bhave* of our *ista mantra*. These sacred ideas imposed on cakras are propagated through nadis to the body regions, and the body thereby gets consecrated.

Herein, the practitioners are aware of the cakras and the divine light (of the Divine Entity) around them. Then they primarily concentrate on the controlling point of the *Piitha*. For example, in the case of the *manipur chakra* (triangular in shape, and red in color), they can concentrate at its centroid and then stimulate it with the divine light by means of their *Ista mantra*; this helps the digestive system, and also the pancreatic hormonal secretion gets affected. All

cakras are thereby brought into the rhythm of the *ista mantra*, to create one tune leading to *Paramapurusa*.

Process: The practitioners first place their mind at the central point of *muladhara cakra* and stimulate (or energize) it with their *ista mantra* 2 to 3 times, with the feeling that in this process the divine light is purifying the *cakra* by wiping off its embedded *vrittis*. Then, they raise their mind to the *svadhisthana cakra* and likewise 'purify' it. They thus keep purifying each *cakra* up to the *sahasrara cakra*. They can now descend, purifying each *cakra* up to the *muladhara cakra*. This constitutes one trip. Like that, they can complete two to three trips.

By ideating at the controlling points of the cakras with the *ista mantra*, the practitioners will be liberated from the associated *vrittis*, and feel a sense of composure in the corresponding region. They will develop a stage of divine composure, and when they will reach the *sahasrara cakra*, the divine nectar secreted from that point will make them realize complete peace pervading their body.

Energizing the cakras to regulate the organs: The Cakras also link the mind and body through their association with the endocrine glands, as depicted in **Figure 6**. By this linkage, they also affect the organs and have a physiological curative role. The cakras are also associated with and control specific endocrine glands, as also depicted in **Table 1**. The cakras regulate organs' functions through these glands, by stimulating their hormonal secretions; this is how the cakras influence the body. So, by spiritually energizing the cakras with the *ista mantra*, the associated endocrine glands can secrete benefitting hormones into the organs. In this way, the organ systems get affected

and cured of their ailments. For example, energizing the Manipur cakra can help to cure diabetes, and energizing the Ajana

cakra can help to alleviate mental depression and dementia.

Table 1 provides insight into how Cakras can influence (i) human expression, instincts, and thinking, and (ii) endocrine glands, to take care of body structures and organs, and cure diseases

Table 1. Association of Cakras with (i) human expressions and human thinking, and (ii) physiological systems

	Seventh Cakra - CROWN Located at the top of the head. Affirmation: "I Am", "I Understand"	Spiritual Centre Development of Psychic Abilities, Enlightenment, Unity. Energizing this cakra can stimulate the Pineal gland, and helps Central nervous system, muscular system, and skin
	Sixth Cakra - THIRD EYE Located in the centre of the forehead Affirmation: "I Know", "I Think"	Perception Centre Psychic Consciousness; Wisdom & Intuitive Ability; Visualization; Power of Mind. Energizing this cakra can stimulate the Pituitary gland, and helps (i) the brain and neurological system, (ii) eyes, ears, nose.
	Fifth Cakra - THROAT Located in the centre of the throat Affirmation: "I Speak", "I Express"	Expression Centre Communication; Inner Voice; Speaking from Truth; Expressions of Creativity (Arts, Music); Will Power. Energizing this cakra can stimulate the Thyroid gland, and helps (i) throat, esophagus, trachea, mouth, jaw, teeth, (ii) neck and vertebrae.
	Fourth Cakra - HEART Located in the centre of the chest Affirmation: "I Love"	Love Centre Compassion; Unconditional Love; Hope; Forgiveness. Energizing this cakra can stimulate the Thymus gland, and helps the heart & circulatory system, ribs & breast, lungs & diaphragm, shoulders, arms, hands.

	Third Cakra - SOLAR PLEXUS Located in the area above the naval Affirmation: “I can”, “I Do”	Power Centre Self-confidence and Esteem; Manifestation. Energizing this cakra can stimulate the Adrenal glands, and take care of (i) stomach, pancreas, upper intestines, liver, gall bladder, and (ii) middle spine.
	Second Cakra - SACRAL Located in the lower abdomen, genitals, wombs. Affirmation: “I Feel”, “I Want”	Creativity and Sexuality Center. Relationship with Money, Career and Power; Procreation; Ability to Feel Joy and Pleasure. Balancing this cakra helps the sexual organs, large intestine, lower vertebrae, pelvis, hip area, and urinary bladder.
	First Cakra - ROOT Located at the base of the spine Affirmation: “I Do”, “I Am”	Survival and Security Centre. Family Connections; Animal Instinct; Controls Fear; Helps in Grounding. Balancing and energizing this cakra helps the Spinal column, rectum, legs, bones, feet. It energizes the body, and increases overall health.

V. Physiological Characterization of the “Meditative State” by EEG, showing its Therapeutic Value

1. Association of EEG waves with mental state

States of rest, sleep, and mental activity have been characterized through the frequency analysis of electroencephalographic (EEG) data. Electrical activity from the brain is displayed in the form of brainwaves on an EEG waveform. There are three predominant categories of brainwaves based on the level of activity. Beta waves (12 to 38 Hz) are predominant during the normal

waking state when one is engaged in cognitive tasks being alert and engaged in problem-solving or decision making. Alpha brainwaves (8 to 12 Hz) are dominant when the mind is quiet, and also during meditation. Theta brainwaves (3 to 8 Hz) occur in deep meditation. During this state, the senses are withdrawn from the external world and focused on the internal mind. It has been noted that a mentally-disturbed person (with a primarily beta EEG pattern) has a lesser proportion of alpha waveforms when compared to one with a calmer mental state.

Characterization of subjective states of feeling associated with the EEG brain waves: (i) the ‘beta’ state is associated with worry and anxiety, (iii) the alpha state has been noted to be associated with pleasant feeling, wellbeing, tranquility, relaxation, (iv) abundance of alpha-wave activity is considered to represent a state of relaxation and relief from concentration, (v) progressive lower frequency states (from beta to alpha and more pronounced increased alpha-activity shift to lower frequency alpha states) are associated with increased relaxation and tranquility, culminating in a deep ‘internalized’ state (of warmth, love, and contentment) in the theta state, (vi) the ‘theta’ state is characteristic of a blissful mind state [9].

2. EEG Response Characterization of the Meditative State

In our study [10], for each subject, the EEG was recorded for 15 minutes with the subject

in a relaxed but mentally active state, with the eyes closed. Then, the subject was asked to ‘meditate’ and the non-meditator was asked to ‘concentrate’, and their EEG was recorded during this period, which normally lasted for 30 min. A recording of the post-meditative or post-concentration period was also taken for 15 minutes. Frequency spectral analysis of the EEG data was carried out to determine the percentage of waves corresponding to each frequency band, as histograms [10].

3. Results

The EEG analysis of an **IP practitioner Subject 1** (a regular practitioner of meditation) is shown in **Figure 7**. The figure shows the percentage of waves corresponding to each frequency band, as histograms. It is seen that for Subject 1, there is a pronounced shift to a lower frequency spectrum during meditation.

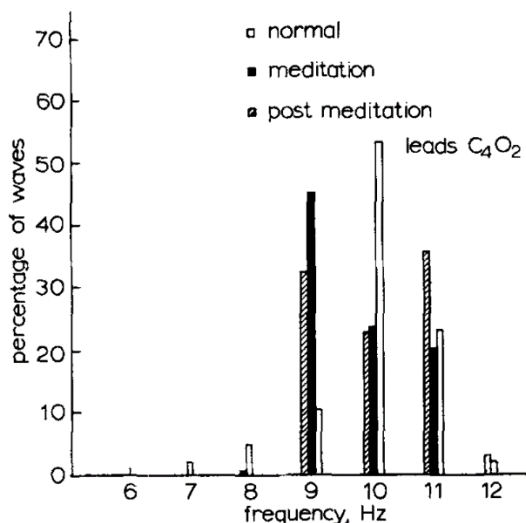


Figure 7. The relative abundance of waves at various frequency bands of Subject 1 who is a regular practitioner of IP, before, during, and after meditation.

Figure 8 shows the wave distribution for the **non-meditator subject 2**. For this subject, the frequency spectrum in a normal state was in a higher frequency band compared to that of a

regular meditator. Also, when this subject ‘concentrated’ there was no shift in the EEG frequency distribution. The distribution is grouped around the intrinsic frequency of 10 Hz.

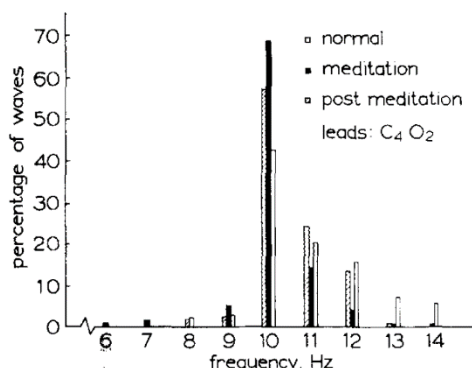


Figure 8. The relative abundance of waves before, during, and after meditation for a non-meditator subject 2.

Figure 9 shows the wave distribution for **Subject 3, who is another IP practitioner and instructor.** Again, there is an abundance of waves at various frequency bands, but especially there are more waves in the lower theta frequencies.

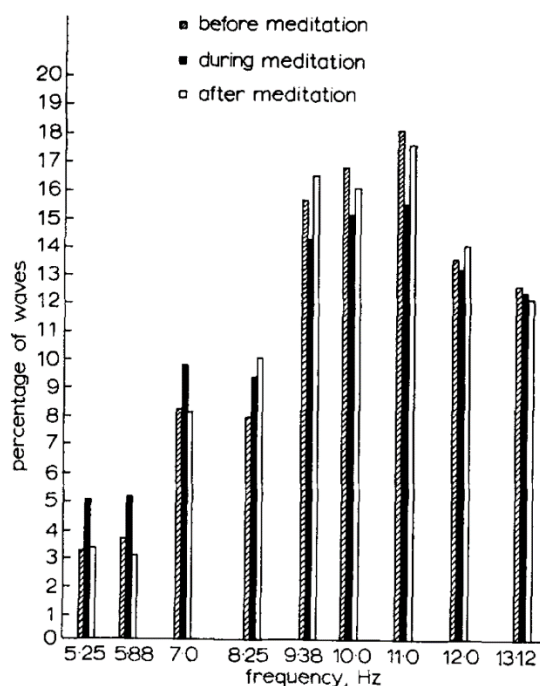


Figure 9. The relative abundance of waves at the various bands for Subject 3 before, during, and after a session of IP. The subject is an adept and an instructor of IP

EEG alpha waves (8 to 12 Hz) relative to beta waves (12.5 to 30 Hz), are associated with a more relaxed mental state, and EEG

theta waves (4 to 8 Hz) relative to alpha waves, are associated with deeply relaxed mental state and higher consciousness

feeling. We need to apply this procedure to a big number of subjects. **Then the effectiveness of meditation can be characterized in terms of (i)** the decrease in the percentage of alpha waves (8 to 12 Hz) from before to after meditation, and **(ii)** increase in the percentage of theta waves (4 to 8 Hz) from before to after meditation.

VI. Meditation Effectiveness Index

EEG response to meditation is one way to demonstrate its effectiveness.

We have also developed another simple way for it. We know that meditation can enable decrease of heart rate (HR). So let us say that we monitor the HR at the start of meditation (HRs) by means of a wearable device. Let HRt be the heart rate at time t during meditation.

Now let us plot **HRt vs time**, and then simulate this data by means of this expression:

$HR_t = HR_s t^{-k}$, to determine the value of k

(1)

Let HRf be the final value of HR at the end of meditation.

We can then develop the expression for **Meditation Effectiveness Index (MEFI)** = $k [(HR_s - HR_f) / HR_s] (100)$ (2)

Greater the value of k and MEFI, the more effective will be the meditation. So we can develop a wearable device that can determine MEFI for meditation subjects, to determine the effectiveness of their meditation. **This will be the first such meditation effectiveness index device.**

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