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A Literary review on Buddhi (IQ) and Smriti (Memory)–An Ayurveda approach

Review Article

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Abstract

Mana (mind) is one of the important things in life which leads to overall health. *Smriti* (memory) is the remembrance of what has been experienced directly earlier. It is described as one among the eight *Aishwaryas* (desire of power) which only happen through the concentration of the mind. *Buddhi* (Intellect) is also known as *Mahata* (greatness), *Upalabidhi* (accomplishment), and *Gyana* (intellectual). *Grahana* (grasping) and *Dharana* (retaining) capacity are the most important properties of intellect because of this knowledge can be retrieved by *Smriti* (memory). In the modern era due to stress, and disturbing emotions there is an increase in incidences of psychosomatic disease. Aim and objectives: The main aim is to explore and review IQ and memory through the Ayurveda approach. Materials and methods: The source for this study is collected from the classical *Ayurvedic* books and commentaries, modern medical science textbooks and different articles from Pubmed, DHARA, Google scholar etc. Result: There is an elaborate description of various mental faculties like Buddhi (intellect), *Mana*s (mind), and *Smriti* (memory) in the ancient Indian texts including Ayurveda texts. Conclusion: Exploration of IQ and memory through the Ayurveda approach helps better understanding of IQ and memory which can improve the practical utility and clinical applicability of these Ayurvedic concepts. Clinically, the anatomic and physiologic knowledge of both IQ and memory will not only facilitate choosing the right medicinal formulations but also definite *Panchakarma* procedures for the best outcome in the prevention of diseases and cure the neuromotor or neuro-behavioural ailments in which both IQ and memory get defected.

Key Words: *IQ, Memory, Ayurveda, Buddhi, Smriti, Mana.*

Introduction

The process of acquiring *Gynana* (knowledge) needs coherence of four acts namely *Indriya* (sense organ), *Indryartha* (subject of sense organ), *Mana* (mind) and *Atma* (soul). *Mana* (mind) conjugates with *Atma* (soul) for acquainting knowledge. The information which is *Indriyasapekshya* (perceptible to senses) can be perceived through respective *Indriya* (sense organ), which perceive their respective *Indriyartha* (subject) through specific *Indriya* (sense organs). The information which is *Indriyanirapeslya* (non -perceptible to senses) has to undergo *Chintya* (thinking), *Vicharya* (thought), *Uhya* (logic), and *Dheya* (meditation) which are the faculty of the mind. At this level the data sorts out into *Gunayukta* (with quality), *Doshayukta* (with *dosha*) by *Sankalpa* (determination). This group of data develops *Buddhi* (intellect) (1). *Smriti* (memory) is the remembrance of things directly perceived, heard or experienced earlier (2). *Smriti* (memory) is the process of encoding, storing and retrieving all the information. It has an important role in the perception of *Buddhi* (intelligence).

Smriti (memory) is associated mostly with *Buddh*i (intelligence) and Mana (mind). It is retrieved by the synchronous firing of neurons recreating the past experiences that were involved in the original experience. In the retention of knowledge Mana (mind) plays an important role and through the different *Gyanendriyas* (sense organs) it coordinates with the *Atma* (soul).

For reasoning and logic, the psychological faculty is *Buddhi* (intelligence). *Buddhi* (intelligence) is described as either *Indriyabuddhii i.e Cakshubuddhi, Srotrabuddhi* etc. or *Manobuddhi*. It is the process leading to true knowledge (3) with the help of *Gyanendr*iya (cognitive organ-nose) together with *Manas* (mind), objects are perceived. In the beginning, the perception is purely mental and practical advantages and disadvantages are ascertained thereafter. *Buddhi* (intellect) determines the specific properties of the object and provokes an individual to act or to speak accordingly. Perception depends upon contact with various sense faculties and their subjects (4). Intellect included the action of *Ahankara* (ego) (5). On the basis

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of sensual perception *Buddhi* is classified into *Panchendriya Buddhi* and *Mano-Buddhi*(6)

Mano-Buddhi: Intellect produced from *Manas* (mind) is known as *Mano-Buddhi*. It is responsible for the factors like *TatvaGyana* (Conceptual thinking), *Dharana* (Retaining), *Grahana* (Grasping) etc.

Panchendriya -Buddhi: Buddhi is related to each of the *Panchendriya* (five sense organs). It is divided into five varieties i.e.*Srotra-Buddhi* (sound perception), *Sparshan-Buddhi* (tactile perception), *Rupa-Buddhi* (visual perception), *Rasana-Buddhi* (taste perception), and *Ghrana-Buddhi* (smell perception). Each *Indriya -Buddhi* imparts instant knowledge of concerned *Indriya-Gyana* (sensual information) (7)

Buddhi the attribute of intellect or cognition is of two types.

- *Smriti* (memory)
- *Anubhava* (experience)

Buddhi Gunas:

- *Ishtanishtavipathi* - Feeling of liking and disliking.
- *Vyavasaya-Vyavasayotsaha* -Enthusiasm to do activities and initiating capacity
- *Samadhit*a - *'Cittavritti-nirodhah* (undistractibility)
- *Pratipatti* -To acquire knowledge by (i) *Pratyaksh* (sensual perception) (ii) *Anumana* (inference) (iii) *Sabda* (verbal testimony) (iv)*Upamana* (analogy)
- *Grahana* - Grasping power (one of the features of intelligence)
- *Dharana* - Retaining power of learnt knowledge, (The feature of intelligence)
- *TatvaGyana* - Conceptual thinking
- *Dhi* -Power to distinguish well from the bad
- *Dhriti* - Firmness or resolution
- *Smriti* - stored previous experience

Materials and Methods

The source for this study is collected from the classical Ayurvedic books and commentaries, Modern medical science textbooks and different articles from Pubmed, DHARA, Google scholar etc.

Results

There is an elaborate description of various mental faculties like *Buddhi* (intellect), *Manas* (mind), and *Smriti* (memory) in the ancient Indian texts including *Ayurveda* texts.

Anatomical consideration of *Indriya Buddhi Sthan*

***Srotra Buddhi* (sound perception) or auditory areas (8)**

Part of the cortex: It occupies the supramarginal gyrus and is concerned with auditory word images. The posterior area is close to both the acoustic cortical area & visual area and is therefore concerned with the integration of auditory and visual data required for the understanding of spoken and written words.

Temporal lobe

Audio- sensory area

- Location: Superior temporal gyrus (middle part) and Heschl's gyrus (anterior transverse temporal gyrus) on the floor of the lateral sulcus.
- Function: Centre for hearing, the consciousness of sound, its quality, pitch, frequency, direction etc. qualities of sounds are perceived.
- Lesion: Impaired hearing.

Audio-psychic area -

- Location - rest of superior temporal gyrus
- Function: Correlation of sounds received with the experience and interpretation of the sound heard.
- Lesion: Agnosia.

Sparshan Buddhi (tactile perception) or touch areas (9)

Parietal lobe

- Sensory association (parietal area)
- Sensory-motor areas: Many motor fibers arise outside the motor cortex.
- The primary motor area: Lies in the pre-central gyrus. It controls voluntary movements of the contra-lateral half of the body e.g. fingers & thumb are the largest area of cortical representation. The paracentral lobule part of it is for the foot and perineum.
- Frontal eye field: It is a part of the primary motor area it has cortical control of visual attention and eye movements
- Primary sensory area: Sensations derived from the skin are appreciated in the anterior part of the area and proprioceptive sensation in the posterior part of the area.
- Cortical representation: Opposite half of the body is represented in an inverted manner.
- In the lower part of postcentral gyrus: Face, oral cavity, pharynx and abdomen. In the lower part- from below upwards – head, neck, trunk and lower limb.

In the posterior part of the paracentral lobule-

Location: Foots and external genitalia.

- Function: Receives both exteroceptive (pain temperature and touch) and conscious proprioceptive sensations.
- Lesion: Loss of appreciation of sensation of the opposite side but some recognition of pain and temperature remains.

Supplementary

- Sensory area: Lie between the lower end of the primary area and lateral sulcus. This area is associated with the appreciation of pain and understanding of shape thus enabling recognition of an object.

Rupa Buddhi (visual perception) or visual areas (8, 9)

Occipital Lobe

Visuo-sensory

- Location: The occipital lobe (Medial surface) lies in the lingual gyrus and cuneus.

- Function: Receives temporal retina of the same side and nasal retina of opposite side i.e. right cortex receives left half of the field of vision, recognition of colour, form, size, motion, etc. of an object.

Cortical representation

Sulcus in the upper retinal quadrant (upper lip) and in the lower retinal quadrant (lower lip)

Lesion - Homonymous hemianopia of the opposite side with macular sparing.

Visuopsychic area - Parastriate and Peristriate - These two areas surround the striate area except anteriorly.

- Function: Evaluation of visual impression reaching
- Lesion: Visual Agnosia, i.e. objects are seen cannot be interpreted properly.

Occipital eye-field area - Peristriate area

Fibres arise from a part of the occipital lobe cortex and pass through the posterior limb of the internal capsule to nuclei of cranial nerves which supply the muscles of the eyeball. These fibres form the reflex pathway for accommodation reflex which is partly voluntary control. The lesion causes loss of accommodation.

Frontal eye-field

- Location - Middle frontal gyrus (Posterior part).
- Function - Horizontal conjugate movements of eyes. The stimulation causes conjugate deviation of eyes to the opposite side.
- Lesion - Loss of horizontal conjugate movements of the eye.

Rasana Buddhi (taste perception) or gustatory areas (9)

They are concerned with muscular activities inherent in speech and with an understanding of language and are concentrated on one hemisphere usually this is the left hemisphere in right-handed and vice-versa. Five brain areas are functionally concerned with speech.

Motor speech area

Broca's area -It is a part of the primary motor area.

- Location - Pars triangularis and pars orbitalis of inferior frontal gyrus on the superolateral surface on the left side of right-handed person.
- Function - Co-ordination of movements of tongue, lips, larynx and other movements employed in the production of voice and articulation of speech.
- Lesion - Sensory aphasia - Not understanding of spoken or written words. The superior area is part of the supplementary motor area & lies on the medial surface.

Sensory areas

Cortex - It occupies the angular gyrus and is a reading centre since it is concerned with visual word images.

- Location - Inferior parietal lobule including supra-marginal and angular gyrus.
- Function - Understanding of written and printed words.
- Lesion - Sensory aphasia -Not understanding of spoken or written words.
- Stereognostic area–
- Location - Superior parietal lobule.
- Function - Stereognosis i.e appreciation of shape, size and texture of an object without aid of vision.
- Lesion - Astereognosis- Inability to identify objects by touching

Gustatory area - Located at the bottom of postcentral gyrus - responsible for the conscious sensation of smell.

The taste area are in the post-central gyrus and taste area I, is buried in the insular cortex.

Functions: Conscious perception of taste.

Ghrana Buddhi (smell perception) or olfactory areas (10)

Primitive areas like pre-pyriform cortex, amygdale, and medial dorsal nucleus of the thalamus.

Functions: Detection of smell as a part of protective measures. Other parts are concerned with sensory integration. The olfactory area is small in man it is situated over the anterior end of the uncus and para-hippocampal gyrus.

Prefrontal cortex (frontal association cortex) - it is related to intellectual activity, emotional behaviour and control of autonomic activity.

The dominant hemisphere is concerned with consciousness, speech, and arithmetical analysis calculation.

Non-dominant hemisphere is concerned with 3-D geometry, musical sense, artistry and synthesis of coherent thoughts.

Mano-buddhi

Importance of Pre-frontal area (11)

The Pre-frontal area of the cerebrum is the site of working memory. Working memory is vital for comprehensive, understanding, planning, reasoning, fearing and decision-making.

The pre-frontal area discriminates the sensory impulses, correlates them with stored impressions and helps in the final response through the ideo-motor area *(Sarvavyavaharahethu)*.

The pre-frontal areas associate themselves with other lobes of the brain like the parietal, occipital, and temporal lobes and with other parts like the thalamus, diencephalon, hypothalamus, tegmentum, visual and auditory areas and act as planning organs *(Vyavasayita)*.

The pre-frontal lobes help in complex intellectual activities like giving judgment and taking decisions *(Niscayatmika Buddhi)*.

Pre-frontal areas, the executive centres, implement the actions after analysis through their connections with the hypothalamus and brain stem and by influencing the autonomic nervous system and endocrinal system.

The functions of the prefrontal cortex are

- Here Short-term memories are registered.
- It forms the centre for the higher functions like emotion, learning, memory and social behaviour.

- It is also called the organ of the mind as it is the seat of intelligence.
- It is responsible for the personality of the individuals.
- Responsible for different autonomic changes during emotional conditions, as it is connected with the hypothalamus and brainstem.

***Smriti* (memory) Physiological Aspect:**

The functional representatives of our body are *Doshas*. *Dosha* which controls the normal functioning of the mind and its activities mainly is *Vata dosha*. *Udana Vayu* is the main Dosha involved in the process of attaining Smriti (memory) (12). *Prana Vata* also contributes to the processing of memory and it maintains the proper activity of *Buddhi* (intelligence), *Mana* (mind) and *Indriya* (sense organ) (13). Proper functioning of *Buddhi* (intelligence) and *Mana* (mind) is responsible by *Sadhaka pitta* which resides in *Hridaya* (heart) (14) Protection and nourishment of sense organs in the brain is provided by *Tarpaka Kapha* which resides in the head (15). *Udana Vayu, Prana Vayu, Sadhaka pitta, Tarpaka Kapha* operates in support of one another in the processing of memory. The eight factors that bring about a good memory are (16)

- *Nimitta* (Knowledge of cause)
- *Rupa grahana* (Knowledge of form),
- *Sadrusya* (Knowledge of similarity),
- *Saviparyaya* (Knowledge of contrast),
- *Satwanuvandha* (Concentration of mind),
- *Abhyasa* (Practice),
- *Gyanayoga* (Attainment of metaphysical knowledge),
- *Punahsrutat* (Subsequent partial communication of an event).

Relation of *Buddhi* (intelligence) & *Smriti* (mind) with *Prakriti* & *Sarata*

From the eight *Sarastwaksara Purusha* possesses good intellect and *Sattvasara Purusha* has a good memory. *Srutagrahi* (good grasping power), *Alpa smriti* (poor memory) (17) and *Chala smriti* (unstable memory) (18) are endowed with *Vata Prakriti*. The individuals with *Pitta Prakriti* are considered to be *Medhavi* (intelligent person) (19). Individuals with *Kapha Prakriti*, are *Chiragrahi* (low grasping power) and *Smritiman* (good memory) (20). From *Manasa prakriti*, *Satwika prakriti* is having good memory.

Modern Aspects of memory

In the nervous system, neurons are the basic unit for the transformation of information. A specific type of neuron is called a sensory neuron can detect a stimulus. In the nervous system, Sensory information travels by communicating with other neurons through an electro-chemical process. This sensory stimulus in the sensory memory is held for a fraction of a second. Short-term memories are stored in the prefrontal lobe of the cerebral cortex. Long-term memories are accumulated in multiple regions throughout the nervous system. The cerebral cortex is activated either through the process of Mana (mind) or excitatory signals. The general mechanism of positive feedback that allows any beginning activity in the cerebral cortex to enhance still more activity is when the signals are sent from the cortex to the brain stem's excitatory area, which in turn sends still more excitatory signals to the cortex. This helps to sustain the level of excitation of the cerebral cortex or even to enhance it. The thinking process helps for the establishment of long-term memories by activating such back-and-forth reverberation of signals. The reticular inhibitory area is important in controlling brain activity (21) Limbic system has an important role in the processing and storage of memory. It is the neuronal circuitry that controls emotional behaviour and motivational drives. The hippocampus which is a part of the limbic system is a critical decision-making neuronal mechanism that determines the importance of the incoming sensory signals. It provides the translation of short-term memory into long term memory by transmitting some signal to make the mind rehearse over and over the new information until permanent storage takes place (22)

The stimulated areas of the limbic system, thalamus, and reticular formation help in determination like pain, displeasure, comfort, pleasure, basic modalities of sensation, localization in gross areas of the body, and other characteristics. Memories are stored in the brain by changing the basic sensitivity of synaptic transmission between neurons as an outcome of previous neural activity. The new pathways are named memory traces. Once the traces are established; they are activated by the thinking mind to reproduce the memories that can take place at all levels of the nervous system. Areas in the basal limbic regions of the brain decide whether the information is important or unimportant and make the subconscious decision whether to store the thought as a sensitized memory trace or to suppress it.

Memories are classified into:

- Short term memory:
- The intermediate long-term memory
- Long- term memory

The prefrontal areas keep track of information and recall this information whenever it is needed is called the Brain's "working memory." (23).

It is again divided into two types.

- Explicit memory- It is with consciousness or at least awareness, also called the declarative memory
- Implicit memory – In which awareness does not involve, also called non-declarative memory or reflexive memory

After thoroughly learning Processing of explicit memory occurs in four stages, explicit memory can become implicit memory:

- Encoding - It is the process in which newly learned information is processed and attended.
- Consolidation- It alters the new information for long term storage.

- Storage - Retention of memory at specific sites of the brain.
- Retrieval - Recall and use of storage information.

When sensory experiences are linked to strong emotions, consolidation of memory to long term memory occurs. Positive or negative memory refers to when the brain decides what needs to be remembered and what is to be forgotten. We only remember the parts of our childhood that are associated with strong emotions. Emotionless experiences are better forgotten so that memory space in the brain is not taken up. The Amygdale stores memory that related to emotions (24)

Discussion

Smriti (memory) comes from the *Buddhi* (intelligence) which is processed with the help of *Mana* (mind), *Atma* (soul), *Indriya* (sense organ), and *Indriyartha* (sense object). Every individual production of knowledge starts with the perception and grasping by *Indriya* (sense organ) and then it goes through the internal process of *Manas* (mind), the subject is then analyzed by means of *Chintan* (thinking*), Grahana* (grasping), *Charana* (retaining) *Vichara* (thought) and categorized into *Nitya* (eternal), *Hita* (useful), *Ahita* (harmful). Then the quick action is performed if needed, otherwise, it is stored as *Smriti* (mind) (24)

*Buddh*i (intelligence) is manifested with the combination of *Manas* (mind) and *Atma* (soul). Intelligence can be correlated with the concept of *Buddhi*. *Buddhi Sthana* (place of intelligence) may be considered mainly as the thalamus, prefrontal lobe, hypothalamus, and other regions of the cerebral cortex etc. Buddhi (intelligence) monitored the coordinated activities of all these structures like concentration, memory, orientation and initiation etc. (25)

Smriti (memory) is a component that brings about attachment. It is obvious that without Smriti (memory), the function of *Buddhi* (intelligence) is impossible. Without *Vichara* (thoughts), *Buddhi* (intelligence) cannot develop which comes through *Smriti* (memory) or past experiences.

Buddhi (intelligence) is of two types.

- *Kshanika buddhi* (short term memory)
- *Nischyatmika buddhi* (long-term memory)

Kshanika buddhi (short-term memory) may be correlated with working memory. The Prefrontal area of the cerebral cortex keeps track of many bits of information simultaneously and results in the recall of this information instantaneously as it is needed for subsequent thought which is required to develop *Kshanika buddhi*. The *Kshanika buddhi* (short term memory) may be converted into *Nischayatmika buddhi* (long term memory) if the hippocampus enhances the rehearsal of information *Kshanika buddhi* (short term memory) repeatedly will transfer into *Nischayatmika buddhi* (long term memory) by initiating physical, chemical, and anatomical changes in the synapse which are responsible for the long-term memory. Structural changes that occur during the development of *Nischayatmika buddhi* (long-term memory) are as follows.

- Increase in vesicle release site for secretion of transmission substance
- Increase in the number of transmitter vesicles released.
- Increase in the number of presynaptic terminals
- The Changes in structures of the dendrites spine permit the transmission of stronger signals.

These three traces help in the recollection of memory they are:

- *Drista* (visual traces)
- *Sruta* (auditory traces)
- *Anubhuta* (experience memory traces have already been formed)

These three through visual and auditory sensory information reach to the area, which is the area for intellectual function as well as comprehension of words. After that memory traces are formed at all levels of the nervous system. The eight causes of Smriti (memory) are

- *Nimitta* (Knowledge of cause)
- *Rupa grahana* (Knowledge of form)
- *Sadrusya* (Knowledge of similarity)
- *Saviparyaya* (Knowledge of contrast)
- *Satwanuvandha* (Concentration of mind)
- *Abhyasa* (Practice)
- *Gyanayoga* (Attainment of metaphysical knowledge)
- *Puahsrutat* (Subsequent partial communication of an event)

These eight causes of *Smriti* (memory) help in the recollection and transformation of knowledge from short-term memory to long-term memory. It is stored in the cerebral cortex. When a person is exposed to any cause of memory, the thalamus plays an important role in helping the person to "search" the memory storehouse and thus read out the memory. So, these eight causes possess the ability to search and find the memory at a later date. *Chintya* (thinking), *Vicharya* (thought), *Uhya* (logic), *Dheya* (meditation), *Sankalpa* (determination) are the five processes that help in the generation of *Buddhi* (intelligence). It may be concluded that all these five processes of *Mana* (mind) are progressed by the simultaneous stimulation of the cerebral cortex, thalamus, limbic system, and upper reticular formation of the brain stem. *Acharya Charak* has described lack of concentration of mind is the cause due to which direct perception of knowledge is not possible. Meaning there is stimulation of the sensory terminal. At first, the signal transmission is good but becomes less due to a lack of concentration of the mind which is a type of negative memory. If any noxious stimuli excite the facilitator terminal the ease of transmission becomes stronger and there will be the perception of direct knowledge. *Acharya Charak* has accepted this doctrine, while he describes the process of creation. He quotes that the *Buddhi* (intellect) originates from *Avyakta, Ahankara* (ego) (26). Learning is the attainment of sensory information whereas storage and

retrieval of the same information is through memory. A behaviour change is called learning which develops after a thought process based on memory storage. After the formation of *Buddhi* (intelligence), it is stored in the cerebral cortex as memory.

Conclusion

Exploration of IQ and memory through the Ayurveda approach helps better understanding of IQ and memory which can improve better practical utility and applicability of these Ayurvedic concepts. Clinically, the anatomic and physiologic knowledge of both IQ and memory will not only facilitate choosing the right medicinal formulations but also definite *Panchakarma* procedures for the best outcome in the prevention of diseases and cure the neuromotor or neuro-behavioural ailments in which both IQ and memory get defected.

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