Meditation and the brain

This article is an introductory summary of the teachings of Zen Master Thích Thông Triệt on the topic, mainly based on the oral teaching of Bhikkhuni Zen Master Thích Nữ Triệt Như given for the Intermediate Meditation Course Level 1. For a comprehensive in-depth understanding, the reader is encouraged to attend the complete nine-seminar teaching program and read the writings of Master Thích Thông Triệt that are being progressively translated into English.

The first relay station: the reticular formation

The reticular formation is a set of neurons that are located in the medulla part of the brainstem. These neurons project their axons to various parts of the brain. They secrete biochemicals that act as neuromodulators to regulate diverse populations of neurons. The reticular formation has, therefore, a far-reaching impact on the totality of the brain.

Function

The reticular formation has four main functions.

First, it is a relay station which relays information originating from the external world through four sense organs (eyes, ears, tongue and skin) to the thalamus (information originating from the node goes straight to the hypothalamus). From the thalamus, the information travels to the cortex. This is the centripetal (or afferent) path, leading towards the central nervous system. On the centrifugal (or efferent) path that leads out from the central nervous system, the reticular formation relays information from the cortex, or the thalamus, or the hypothalamus to other parts of the body. The reticular formation plays a part in maintaining the body's balance and adjusting postures. It also directs simple body movements and instinctive movements. For example, some of its neurons receive information from the cortex to direct eye movements. Some of its nuclei participate in instinctive movements such as coughing, chewing, swallowing and vomiting.

Second, the reticular formation is an alarm system. When we are deep in sleep and there is a loud noise, the reticular formation is activated and wakes us up so that we can respond to this event. When raising the alert, the reticular formation does not have full information about the event, but it has the function of alerting and raising the attention of the cortex which will then appraise the situation and develop an appropriate response.

Third, the reticular formation maintains arousal and alertness. In particular, it alerts when there is something that may be unfavorable to the self. It helps us maintain a conscious arousal so that we can respond appropriately to events in the external environment without involving the prefrontal cortex areas. If it is damaged, we may fall into a comatose state and not regain consciousness.

Fourth, the reticular formation controls the wakefulness of the cortex. It directs the focus of attention and helps us make the most of the energy of attention through the four sense organs of the eyes, ears, tongue and body. When we practice focusing on the breath during meditation, we are using the reticular formation's capacity for attention.

The second relay station: the thalamus

Location

The thalamus and hypothalamus form the diencephalon. They are located between the two hemispheres of the brain and above the midbrain.

Information received from the sense organs goes through the reticular formation, then through the thalamus before reaching the lobes of the cortex. Information from the eyes, the ears, the tongue and the skin reaches the reticular formation first and then the thalamus, whereas information from the nose travels direct to the hypothalamus and then to the thalamus.

The thalamus consists of several groups of nuclei. Their function is to make a raw assessment of the information received from the sense organs. From there, the information is disseminated to relevant parts of the brain.

The following structures send information to the thalamus:

- From the reticular formation comes information from the senses of sight, hearing, taste and touch
- From the hypothalamus comes information from the sense of smell as well as the feelings and sensations from inside the body
- From the midbrain comes information about body balance and the direction of sounds
- From the motor cortex comes information about movements of the inner body, the body and limbs

Function

The function of the thalamus is:

- To receive and relay information from the sense organs to the lobes of the cortex (frontal, parietal, temporal and occipital lobes)
- To act as intermediary and relay the following information to other parts of the brain: perception, body movement, cortex wakefulness and memory

The thalamus is the gate to the cortex. The objects of the six senses go through it. Bodily karma and speech karma go through it. It is considered as the second relay station. It plays an important role in processing sensory information, disseminating information to all parts of the brain, regulating the senses of awareness, alertness, attention and the emotional response to the sensory experiences.

The third relay station: the hypothalamus

The hypothalamus is located immediately beneath the thalamus. It is part of the limbic system. Although quite small and weighing only four grams, it is where the states of mind are expressed, be it the worldly mind, the wordless awareness mind or the Buddha mind. It plays a role in almost all aspects of behavior, including eating, sexual activity, sleep, body temperature, mood, internal secretion and movement.

Function

The hypothalamus regulates all activities of the mind and body. It maintains homeostasis, governs many body physiologic functions, and mediates mood and emotional responses. It helps keep our body healthy and our complexion radiant but can also generate psychosomatic illnesses or a degradation of the body. It is considered the center of autonomic functions, as it is the master gland directing the endocrine system. Through the pituitary gland situated just underneath it, the hypothalamus can stimulate or inhibit the release of hormones by other endocrine glands. It also acts on the body through axons that link groups of its nuclei to the sympathetic or parasympathetic nervous systems in the brainstem. These systems in turn stimulate or inhibit the function of lower autonomic centers.

In summary, the hypothalamus plays a coordinating, regulating and controlling role over the autonomic functions inside the body. It is the link between the mind, the brain and the body. It is the link between the nervous system and the endocrine system.

The hypothalamus is the main relay station linking the cortex to lower autonomic centers, in other words, it is the link between the mind and the body. It relays the energy from the cortex to the lower autonomic centers in the brainstem and spinal cord. Through its relaying role, the mind can influence the body, keeping the body healthy or generating mental and psychosomatic illnesses.

Function of the hypothalamus centers

In broad terms, the hypothalamus has nine main centers, each constituted by a group of nuclei.

1. Responding to emotions and expressing aspects of mind, speech and thought.

The hypothalamus plays a facilitation role in expressing emotions such as sadness, joy, anger, screaming, prayer, verbal abuse, trembling, having goose bumps, turning red with anger, turning pale with fear, heart-stopping, roughness, aggression, lust, gluttony, fight or flight, stealing, attack, repentance, meekness, tranquility, resourcefulness or slowness etc. On the other hand, if we attain a state of samādhi, the hypothalamus also expresses this state through our bodily appearance and speech.

2. Monitoring and controlling all activities of the mind and body.

This is achieved through the control that the hypothalamus exerts over the autonomic nervous system. The autonomic nervous system controls blood pressure, heart rate, breathing, the digestive system and inner organs. For example, if we are angry, the energy of anger is sent to the hypothalamus, which immediately translates it, through the autonomic nervous system, into bodily reactions and instinctive movements of arms, legs, head, eyes, lips, mouth and emission of sounds.

The hypothalamus also reacts to activities of the thinking mind (located in the left frontal cortex) and consciousness (located in the right frontal cortex). If these two areas do not send energy that has a dualistic content such as differentiating between evil–virtuous or right–wrong, the hypothalamus will remain silent. It also reacts to stimuli originating from other areas such as smell from the nose, emotional memories from the amygdala or long term memories from the hippocampus, and it

generates biological reactions that reflect these stimuli.

The hypothalamus acts through the portal venous system to stimulate the pituitary gland into releasing six types of hormones. It controls the posterior pituitary through a nerve.

The hypothalamus monitors and regulates the autonomic nervous system. When it receives a danger signal, it activates the sympathetic nervous system resulting in higher heart rate, higher air intake, enlarged irises and increased blood flow and sugar to the muscles in readiness for a fight or flight response.

3. It monitors and regulates the body temperature
4. It regulates the water level in the body
5. It regulates appetite
6. It regulates the sleep–wake cycle
7. It regulates the endocrine system through the pituitary gland, helping keep the body healthy. This is the most important function of the hypothalamus. Buddhist meditation, through the practices of anupassanā, samatha, samādhi and paññā meditations, impacts on the hypothalamus to bring good health to the body and resolve psychosomatic illnesses.

The hypothalamus and meditation practice

The hypothalamus interacts with the false mind, located in the left and right prefrontal cortex, as well as with the wordless awareness mind, located in the rear left hemisphere, and the Buddha mind located in the parietal lobe and the precuneus. When the processes of the false mind are silenced, the hypothalamus acts on the endocrine system and through the circulatory system to relieve mental and psychosomatic illnesses such as diabetes, high blood pressure, nervous breakdown, stomach ulcers, etc. The result is a healthy body and a peaceful mind. The transformation of our mind when we meditate starts with the hypothalamus when we dwell in wordless awareness. This is because the hypothalamus creates the states of mind that initiate the biological effects in our body, starting the process of eliminating mental defilements and old habits, and resolving psychosomatic illnesses. In doing so, it represents the white buffalo that is the metaphor for the wordless awareness mind in Zen Buddhism's "herding the buffalo" pictures.

Regarding the formation of karma, the hypothalamus is related to the mental formations aggregate. It is the function that expresses all states of the false mind into body gestures (including movements of the arms, legs, body, head, face, eyes, skin and inner organs) and speech (including tonality of cries, screams, tender words, hurtful words, irritation etc.). In doing so, it represents the black buffalo that is the metaphor for the false mind in Zen Buddhism's "herding the buffalo" pictures.

The functions of the hypothalamus depend on whether we are awakened or deluded. When we are deluded and constantly operate in our false mind, we will reap the consequences as pain in our body and sorrow in our mind. When we are awakened and practice to control our mind, silence our verbal chatter and dwell in wordless awareness, our holy mind will shine through and our spiritual wisdom will develop. The hypothalamus will then play the central role in resolving our psychosomatic illnesses, bringing health to our body, radiance to our complexion and peace to our mind.

At the highest spiritual level, the hypothalamus acts under the direct influence of Buddha mind located in the precuneus. When the precuneus is active, the hypothalamus immediately expresses outwardly the features of a mind in complete silence and objectivity. The Buddha called this mind pure, malleable, unblemished, wieldy, and imperturbable.

In summary, the hypothalamus is the structure that expresses the three aspects of the mind: the false mind, the wordless awareness mind, and the Buddha mind.

The fourth relay station: the precuneus

Location

The precuneus is part of the cortex. It is located in the parietal lobe in both left and right hemispheres. The precuneus relates to ultimate hearing, ultimate touch, and ultimate cognition. The cuneus, situated behind the precuneus, is related to ultimate seeing.

Characteristics

It is the seat of the tathā-mind, or the Buddha mind (P: Buddhatā), or wordless cognitive self-awareness.

Function

It links with the other three relay stations (reticular formation, thalamus, and hypothalamus) to generate a default mode

network in the middle brain and cortex.

It only receives and transmits selective signals, those of the completely silent mind. When we practice meditation regularly every day, all experiences of samādhi and paññā meditation are automatically stored in the precuneus as a compressive cognitive map inclusive of semantic, procedural, episodic and evoked aspects.

Nó là lõi của não bộ, do vai trò quan trọng của nó đối với toàn bộ não bộ con người.

Due to its primordial role in the function of the human brain, it is considered the central core of the brain.

Vai trò

Role

Nó đóng vai trò chủ động mọi hoạt động của con người, thiên về trí tuệ tâm linh. Nó giúp hài hòa thân tâm. Nó phát huy năng lực sáng tạo tự trong chính con người. Nó giúp con người kinh nghiệm Thoát khổ, Giác ngộ và Giải thoát. Chính từ nơi này tiềm năng giác ngộ của chúng ta phát huy. Từ lần, chúng ta sẽ kinh nghiệm trực giác, tánh sáng tạo, sáng kiến mới, năng lượng từ bi hỷ xả, và năng lực biện tài vô ngại.

It plays a directing role in all human spiritual activities. It helps bring the body and mind into harmony. It develops the creative energy of enlightenment that exists potentially in every human being. It helps us experience freedom from suffering, enlightenment, and freedom from births and deaths. From the precuneus, our potential for enlightenment comes into being. We will progressively experience intuition, creativity, innovation, benevolence, compassion, empathetic joy, equanimity, and eloquence.

Conclusion

Neuroscience plays a very important role in meditation practice. We use modern scientific knowledge of the brain to reconcile with the meditation practices as taught by the Buddha. By understanding the basics of neuroscience, we will be able to clearly understand the difference between a correct and incorrect meditation practice. We will also be able to demonstrate the value of the Buddha’s teaching to modern audiences of all spiritual capacities.

This is the reason why in this article we have described in generic terms elements of neuroscience and the relay stations and their relevance to meditation. This basic knowledge will help us understand the biofeedback process when we practice meditation and realize the true value of meditation. If we do not understand the action and effect relationships between the mind, the Buddha’s teaching, the brain. and meditation practices, we can easily err into an incorrect practice such as auto-suggestion, imagination, effort, and concentration.