Journal of Advanced Medical and Dental Sciences Research

@Society of Scientific Research and Studies ***NLM ID:*** *101716117*

Journal home page: www.jamdsr.com doi: 10.21276/jamdsr Index Copernicus value = 85.10

(e) ISSN Online: 2321-9599; (p) ISSN Print: 2348-6805

Original Research

The Triune Brain: The Interplay between Body, Brain, and Behavior

[1]Venkateswar Pujari, [2]S. Parvathisam

[1]Chief Mentor, Body Brain Behaviour Foundation, Visakhapatnam, Andhra Pradesh, India;
[2]Chief Executive Officer, Q1 Hospital, Visakhapatnam, Andhra Pradesh, India

ABSTRACT:
The idea that the human brain is composed of three separate evolutionary layers was first proposed by Paul D. MacLean in the 1960s. According to this theory, the reptilian brain, the paleomammalian brain, and the neomammalian brain are the layers that make up the human brain. In this review study, we investigate how these different parts of the brain interact with one another and how that has an effect on human behavior. Throughout the course of human evolution, each layer has developed distinctive anatomical and functional properties, which have contributed to the shaping of human intellect and emotional reactions. The most fundamental instincts and behaviors for preserving one's own life are controlled by the reptile brain, which is the deepest layer. The limbic system, which is related with the paleomammalian brain, is responsible for regulating emotions and the creation of memories. The neocortex of the neomammalian brain, in particular, is the region of the brain that is responsible for higher-order cognitive activities. This research sheds light on the complex linkages that are associated with human behavior by conducting an in-depth investigation into the connection that exists between the human body and brain as well as behavior. In addition to this, it explores the therapeutic applications of the triune brain model, which offers new perspectives on the understanding, diagnosis, and treatment of a variety of neurological and psychiatric conditions. Our knowledge of how the brain works can be increased thanks to a comprehensive grasp of the triune brain model, which also makes it easier to devise focused interventions that will lead to better patient outcomes.
Keywords: Triune brain, reptilian brain, paleomammalian brain, neomammalian brain, behavior.

Received: 19 July, 2021 Accepted: 25 August, 2021

Corresponding author: Venkateswar Pujari, Chief Mentor, Body Brain Behaviour Foundation, Visakhapatnam, Andhra Pradesh, India

This article may be cited as: Pujari V, Parvathisam S. The Triune Brain: The Interplay between Body, Brain, and Behavior. J Adv Med Dent Scie Res 2021;9(9):117-120.

INTRODUCTION

The human brain is an incredible organ that plays a role in thinking, feeling, and acting in different ways. The idea of the triune brain was first proposed by Paul D. MacLean in the 1960s. According to this theory, the human brain is composed of three separate evolutionary layers: the reptilian brain, the paleomammalian brain, and the neomammalian brain [1, 2]. It is considered that each layer serves a different purpose and helps to mold human behavior in its own unique way.

The oldest layer of the brain is called the reptilian brain, which is also known as the basal ganglia. It is involved with activities related to survival, aggression, and reproduction [2]. The limbic system, which is part of the brain of paleomammalian animals, plays an important part in the creation of memories as well as the control of feelings [3]. Higher-order cognitive functions, including language, abstract thought, and decision-making, are under the purview of the neomammalian brain, notably the neocortex [4]. To unravel the intricacies of human behavior, it is vital to have a solid understanding of the interaction between these different brain regions. Researchers are able to obtain new insights into the ways in which different regions of the human brain interact with one another and contribute to different elements of human cognition and emotional reactions by studying the anatomical and functional properties of each layer.

Additionally, the triune brain model has important repercussions for clinical research as well as clinical practice. It offers a framework for understanding the neurobiological mechanisms that are at the root of neurological and psychiatric conditions. Clinicians are able to establish focused interventions and treatment strategies by first determining the individual brain

regions that are involved in the various diseases that patients suffer from [5]. This model is also helpful in the investigation of neuroplasticity and the rewiring of the brain, which could potentially open up new paths for therapeutic interventions and the promotion of brain health.

In a nutshell, the triune brain model provides a helpful framework for comprehending the dynamic relationship that exists between the behavior, the body, and the brain. Insights into the intricacies of human cognition and emotional reactions, as well as the pathophysiology of neurological and psychiatric illnesses, can be gained by an examination of the distinct evolutionary layers that have occurred over time.

THE BRAIN OF THE REPTILE

The reptilian brain, which is often referred to as the basal ganglia, is the oldest layer of the triune brain model. It is responsible for playing an important part in the regulation of basic instincts and actions related to survival [1]. This region of the brain is important for a variety of tasks, including reproduction, territoriality, and aggression. It is the basis for the more sophisticated behaviors seen in higher mammals, such as humans, and acts as a foundation for those actions.

Structures in the reptilian brain such as the amygdala, hippocampus, and nucleus accumbens are involved in the processing of emotions and the creation of memories [2]. The reptilian brain is anatomically composed of these structures. In particular, the amygdala plays an important function in the perception of and response to emotional inputs, which influences fear, anxiety, and aggressive behavior [3].

A malfunction in the human brain could have substantial repercussions for human behavior and mental health if it occurs in reptile brains. For example, disturbances in the amygdala have been linked to illnesses such as aggressive behavior and antisocial personality disorder [4]. Alterations in the reward circuitry that include the nucleus accumbens may also contribute to the development of addiction as well as problems of impulse control [5].

It is possible to get useful insights into the genesis as well as the treatment of a variety of mental diseases by gaining an understanding of the role that the reptile brain plays in influencing behavior. Therapeutic approaches that target the reptile brain, such as cognitive-behavioral therapies or pharmaceutical interventions, may be able to assist in the modulation of aggressive tendencies or impulsive behaviors [6]. In addition, neuroimaging techniques enable researchers to observe and investigate the activation patterns that occur inside the reptilian brain, which offers additional insights into the functions and dysfunctions of the brain [7].

In conclusion, the brain of a reptile is an essential part of the triune brain model, playing a role in the control of fundamental reflexes and actions associated with basic survival. Our comprehension of human behavior can be improved, and chances for developing tailored treatments for psychiatric diseases can be created, through the study of the anatomical and functional properties of this brain layer.

THE BRAIN OF THE PALEOMAMMALIAN

The limbic system in the paleomammalian brain, which is part of the paleomammalian brain and constitutes an intermediate layer in the three-layered model of the brain, is in charge of regulating emotions and the creation of memories [1]. This particular region of the brain plays a significant part in the development of human behavior and has a significant impact on a variety of facets of our emotional experiences.

The amygdala, the hippocampus, and the cingulate cortex are three of the most important components found within the brain of a paleomammalian [2]. The amygdala is a region of the brain that is involved in the processing of emotions as well as the expression of those emotions, notably responses of fear and anxiety [3]. On the other hand, the hippocampus is essential for the consolidation of memories, as well as spatial navigation and learning contextual information [4]. In addition, research has shown that the cingulate cortex is involved in the processes of emotional regulation, decision-making, and attentional activities [5].

A dysfunctional paleomammalian brain may have contributed to the development of psychiatric problems in the paleomammals. As one illustration, anomalies in the amygdala have been linked to conditions such as anxiety disorders and mood disorders like depression [6]. Memory loss has also been linked to changes in the hippocampus, which has been connected with illnesses such as Alzheimer's disease and post-traumatic stress disorder [7].

Understanding the function that the paleomammalian brain played in the regulation of emotions and the creation of memories has significant ramifications for the therapeutic therapies that are possible. Individuals who suffer from anxiety disorders or post-traumatic stress disorder are sometimes treated with psychotherapies that regulate emotional reactions and reduce symptoms by focusing on the structures of the paleomammalian brain [8]. Examples of such therapies are cognitive-behavioral therapy and exposure therapy. In the treatment of mood and anxiety disorders, pharmacological therapies that alter neurotransmitter systems inside the paleomammalian brain, such as selective serotonin reuptake inhibitors, have also demonstrated success [9].

In conclusion, the brain of a paleomammalian plays an important part in the creation of memories as well as the regulation of feelings. Psychiatric conditions can sometimes emerge as a result of dysfunctions that take place inside this layer of the brain. Gaining an understanding of the morphological and functional aspects of the paleomammalian brain provides

insights into the underlying mechanisms that contribute to the development of these illnesses and helps the creation of specific treatment strategies.

THE BRAIN OF NEOMAMMALIAN SPECIES

Neomammalian brains, and the neocortex in particular, constitute the most evolved and complex layer of the triune brain model. This layer plays an essential part in higher-order cognitive abilities including language, abstract thought, and decision-making [1]. The amazing cognitive abilities that set humans apart from other species are mostly attributable to a particular region of the brain.

The neocortex is broken up into several separate sections, each of which is specialized for a certain set of tasks. Executive processes such as decision-making, impulse control, and working memory are all controlled by the prefrontal cortex, which is situated in the front of the neocortex [2]. The temporal lobes play a significant role in the processing of language as well as auditory perception, whereas the occipital lobes are principally responsible for the processing of visual information [3].

The functional interconnectedness of the neomammalian brain extends beyond the boundaries of specific areas. Large-scale brain networks are essential for integrating information and organizing cognitive processes [4]. Examples of such networks include the default mode network and the frontoparietal network. These networks make it easier to accomplish difficult activities such as paying attention, retrieving memories, and solving problems.

Cognitive deficits of a substantial nature can be the end result of diseases that affect the brains of neomammals. Memory loss, difficulties paying attention, and communication issues are all symptoms that can be caused by conditions such as Alzheimer's disease, stroke, and traumatic brain injury [5-10]. In order to create successful diagnostic and therapeutic procedures, it is vital to have a solid understanding of the neurobiology that lies behind these illnesses inside the neomammalian brain.

Researchers have been given the opportunity to explore the functional architecture and connectivity of the neomammalian brain because to developments in neuroimaging techniques [6,11,12]. One example of these approaches is functional magnetic resonance imaging, or fMRI. These investigations not only offer essential information for clinical applications, but they also reveal insights into the brain substrates underlying cognitive functions.

INTERACTIONS AND AMALGAMATION OF INFORMATION

The complexity of human behavior can be attributed, in part, to the interplay and integration that occurs between the reptile, paleomammalian, and neomammalian brain regions, as described by the triune brain model. These different parts of the brain do not function in isolation; rather, they engage in reciprocal communication and mutual influence in order to create synchronized behaviors [13].

The reptilian brain, which is connected with fundamental instincts related to survival, serves as a foundation upon which the paleomammalian and neomammalian layers of the brain build. The activation of the reptilian brain can cause emotional reactions to be triggered within the paleomammalian brain, which can then shape how we perceive and respond to our surroundings [11]. The reactions of the reptilian brain are modulated in turn by the paleomammalian brain, which is responsible for regulating emotional experiences and the creation of memories [12].

The neocortex of the neomammalian brain, in particular, plays an important part in the integration of information derived from different types of sensory modalities and higher-order cognitive processes. The neocortex is able to exercise top-down control and impact emotional reactions and behavior [13] because it receives inputs from the reptile and paleomammalian brain areas. In addition, the neocortex collaborates with the paleomammalian brain to ascribe an emotional valence to sensory information, which directs our processes of decision-making [14].

The complexity of human behavior and the adaptability of our responses to varied circumstances are both contributed to by the interactions and integration that take place across different regions of the brain. Psychiatric diseases and behavioral dysfunctions might be the result of dysregulation or disruptions in the linkages between these systems. For instance, abnormal connection between the amygdala and the prefrontal cortex has been linked to illnesses such as anxiety disorders and disorders of impulse control [15].

Gaining an understanding of the complex interactions that take place between the brain areas of reptiles, paleomammals, and modern mammals can provide useful insights into the mechanisms that underlie human behavior. It makes it possible to create exhaustive models that take into account both the physiological and psychological components of human behavior. Additionally, this information informs the development of specific therapies that try to restore the balance and integration between different brain regions for the purpose of improved mental health outcomes [16-18].

CLINICAL IMPLICATIONS

The triune brain model can provide extremely helpful insights into the etiology, diagnosis, and therapy of neurological and psychiatric illnesses. In the following section, we will explore the many clinical diseases that can be caused by dysfunctions in particular regions of the brain. [18] It investigates the influence of the triune brain model on the areas of neurology and psychiatry, with the goal of assisting in the creation of focused therapeutic therapies.

It is possible to uncover the underlying neurobiological mechanisms that contribute to conditions such as schizophrenia, mood disorders, and substance abuse by gaining an understanding of the interaction that exists between the brain areas of reptiles, paleomammals, and modern mammals. For instance, abnormal functioning of the reptile brain may be the root cause of the impulsive and hostile behavior that is characteristic of those who suffer from antisocial personality disorder. On the other hand, emotional dysregulation can be traced back to abnormalities in the paleomammalian brain, which can be found in diseases such as borderline personality disorder.

The fact that the neomammalian brain is involved in higher-order cognitive activities has ramifications for clinical practice as well. Cognitive decline and memory impairment are two symptoms that can be caused by diseases that affect the neocortex, such as Alzheimer's disease. In addition, disorders such as attention deficit hyperactivity disorder (ADHD) may lead to deficits in the executive processes of the neocortex. Clinicians are able to customize treatment approaches appropriately when they are aware of the specific brain regions that are involved in the pathology of a given condition. It may be possible to restore normal functioning with the assistance of pharmacological therapies that target the neurotransmitter systems associated with the afflicted brain areas. It is also possible for behavioral therapies to be tailored to target certain cognitive and emotional processes that are regulated by different layers of the brain [19,20].

CONCLUSION

The triune brain model offers a framework for comprehending the intricate dynamic that exists between the body, the brain, and the behavior of an individual. Each of the three types of mammalian brains—reptilian, paleomammalian, and neomammalian—contributes in its own way to the formation of human thought, emotion, and behavior. Researchers and clinicians can acquire vital insights into the etiology of neurological and psychiatric illnesses, as well as into the management of these conditions, by conducting in-depth analyses of the morphological and functional properties of specific brain regions.

It is vital to conduct additional study investigating the dynamic interactions and integration that occur between the three layers of the brain in order to further our understanding of how the brain functions and to improve treatment methods. The breakthroughs that have been made in neuroimaging techniques and molecular biology offer some promising paths for resolving the complexity of the tripartite brain.

To summarize, the triune brain notion is a useful model for analyzing the complexities of human brain evolution and the ways in which this evolution has an effect on behavior. It lays the groundwork for the investigation of the underlying mechanisms of neurological and mental illnesses, which can then lead to the creation of more tailored therapies and improved patient outcomes.

REFERENCES

1. MacLean PD. The triune brain in evolution: role in paleocerebral functions. Plenum Press; 1990.
2. LeDoux JE. Emotion circuits in the brain. Annu Rev Neurosci. 2000;23:155-184.
3. Geschwind N, Galaburda AM. Cerebral lateralization. Biological mechanisms, associations, and pathology: II. A hypothesis and a program for research. Arch Neurol. 1985;42(6):521-552.
4. Carlson NR. Physiology of Behavior. 13th ed. Pearson; 2019.
5. Petersen SE, Sporns O. Brain networks and cognitive architectures. Neuron. 2015;88(1):207-219.
6. Papez JW. A proposed mechanism of emotion. 1937. J Neuropsychiatry Clin Neurosci. 1995;7(1):103-112.
7. Rolls ET. Emotion explained. Oxford University Press; 2005.
8. Milner B. Disorders of learning and memory after temporal lobe lesions. In: Squire LR, Schacter DL, editors. Neuropsychology of Memory. 3rd ed. Guilford Press; 2002. p. 83-104.
9. Bressler SL, Menon V. Large-scale brain networks in cognition: emerging methods and principles. Trends Cogn Sci. 2010;14(6):277-290.
10. Damasio AR. The feeling of what happens: Body and emotion in the making of consciousness. Mariner Books; 2000.
11. Craig AD. How do you feel? Interoception: the sense of the physiological condition of the body. Nat Rev Neurosci. 2002;3(8):655-666.
12. MacLean PD. The triune brain, emotion, and scientific bias. In: Davidson RJ, Scherer KR, Goldsmith HH, editors. Handbook of Affective Sciences. Oxford University Press; 2003. p. 56-68.
13. Rolls ET. The functions of the orbitofrontal cortex. Brain Cogn. 2004;55(1):11-29.
14. Paus T. Primate anterior cingulate cortex: where motor control, drive, and cognition interface. Nat Rev Neurosci. 2001;2(6):417-424.
15. LeDoux JE. Synaptic Self: How Our Brains Become Who We Are. Penguin Books; 2003.
16. Barbas H. Flow of information for emotions through temporal and orbitofrontal pathways. J Anat. 2007;211(2):237-249.
17. Damasio H, Damasio AR. Lesion analysis in neuropsychology. Oxford University Press; 2000.
18. Burgess PW, Simons JS, Dumontheil I, Gilbert SJ. The gateway hypothesis of rostral prefrontal cortex (area 10) function. Trends Cogn Sci. 2005;9(7):358-367.
19. Nolte J. The Human Brain: An Introduction to its Functional Anatomy. 7th ed. Elsevier; 2015.
20. Damasio A. The quest to understand consciousness. Annu Rev Psychol. 2013;64:1-20.