
THE BRAIN Vs. THE EMOTIONS

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I OBJECTIVE

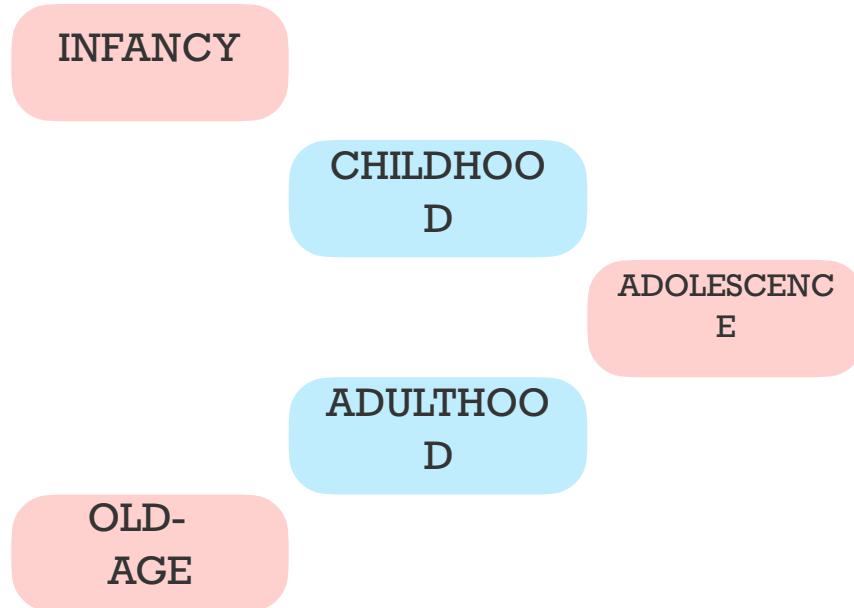
The essence of Emotions always revolves around living beings, and majorly Humans. We live in a world, where we are surrounded by people at every significant stage of life playing different roles.

This was our very inspiration, therefore, we decided to analyze the variations in the emotions of a human being throughout the life-cycle, through all its stages due to variation in experience and physical changes of the brain due to aging.

After all, the world's a stage and we are all actors!

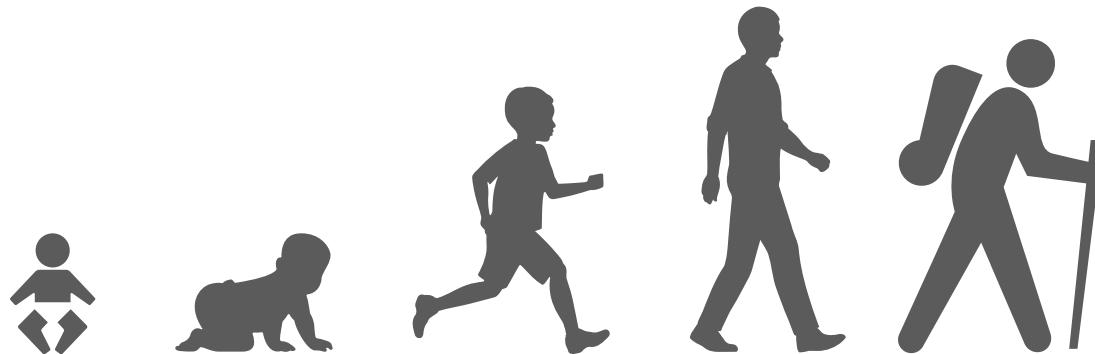
II PROJECT OVERVIEW

Let us analyze various Stages of Human Life :



We can classify Stages of Human Life as mentioned above, where Infancy can further be classified as Intra-Uterine period and Post-Natal Development period. Similarly, Childhood may be classified as Early and Later Childhood, Adolescence may be - Early Teenage and Later Teenage and finally Old Age may be categorized as Later Adulthood and Death.

This is the complete Human Life Cycle which involves innumerable variations in Emotions as well as the physical structure of the Brain (Experience & Aging).



In this project, we will be technically delving into the very first stage of Human Life, that is **Infancy**. Furthermore, this creates an overwhelming Future Scope of the Project and may be pursued further for the later Four Stages in great detail.

III Intra-Uterine Stage : Physiological Variation

When we talk about the physiological development of the fetus's brain, we refer to it's exponential growth from the embryonic structure to development of proper brain stem and Limbic System.

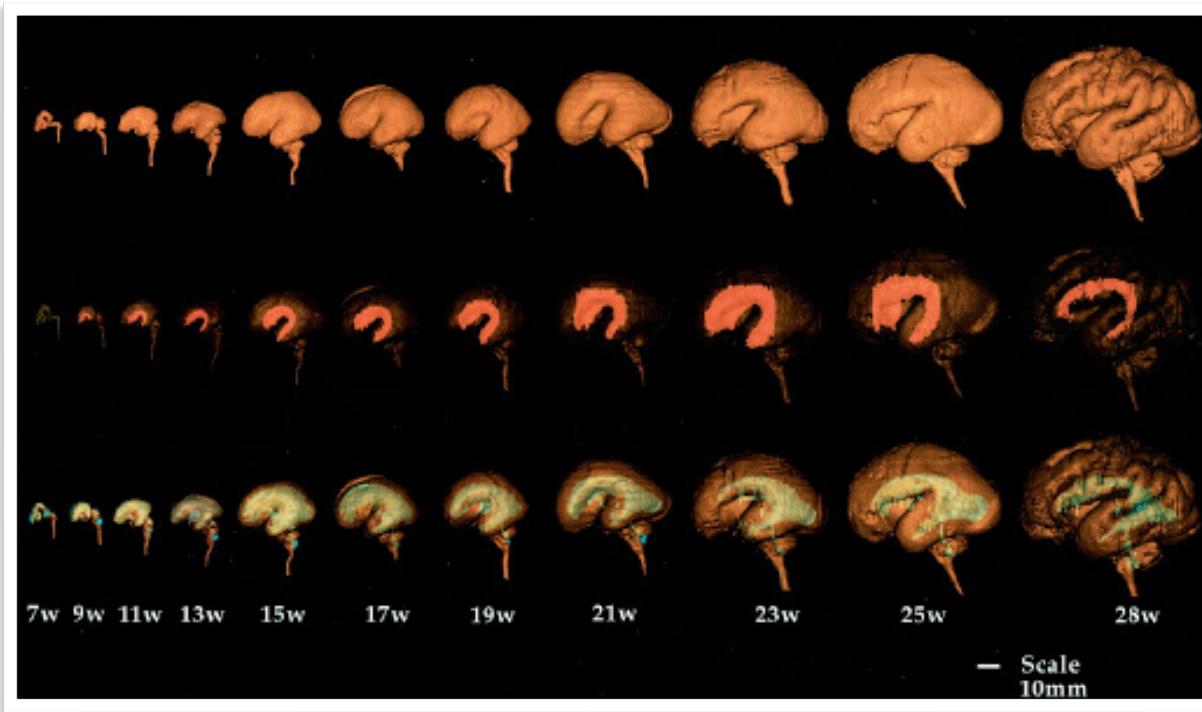


FIG. 1 : The above Image represents the Growth of Brain of the Fetus upto 28 weeks

One of the imperative factors affecting the fetus is the mother's emotions. The association between maternal psychological well-being during pregnancy and fetal welfare has recently attracted increasing attention.

In addition to stress, persistent negative maternal emotions during pregnancy such as anxiety, depression, and anger also exert an influence on fetal and later development of a child.

According to a research, monitored fetal movements of arm, leg, and trunk separately by means of

two ultrasound apparatuses while maternal emotions were manipulated by film clip presentation. The ultrasonographic observation revealed that the number of fetal arm movements increased when pregnant women were being shown a happy film. However,

fetal arm movements decreased during presentation of a sad film. These findings suggest that induced emotions in pregnant women affect arm movements of their fetuses, and the effects of positive and negative emotions on fetus movements are opposite.

The fetal leg movements were not affected by maternal happiness or sadness and the fetal trunk movements were also not affected. In this case, the effects of maternal emotions could not be detected by counting the number of leg or trunk movements possibly because trunks and legs were too big to easily move inside the uterus.

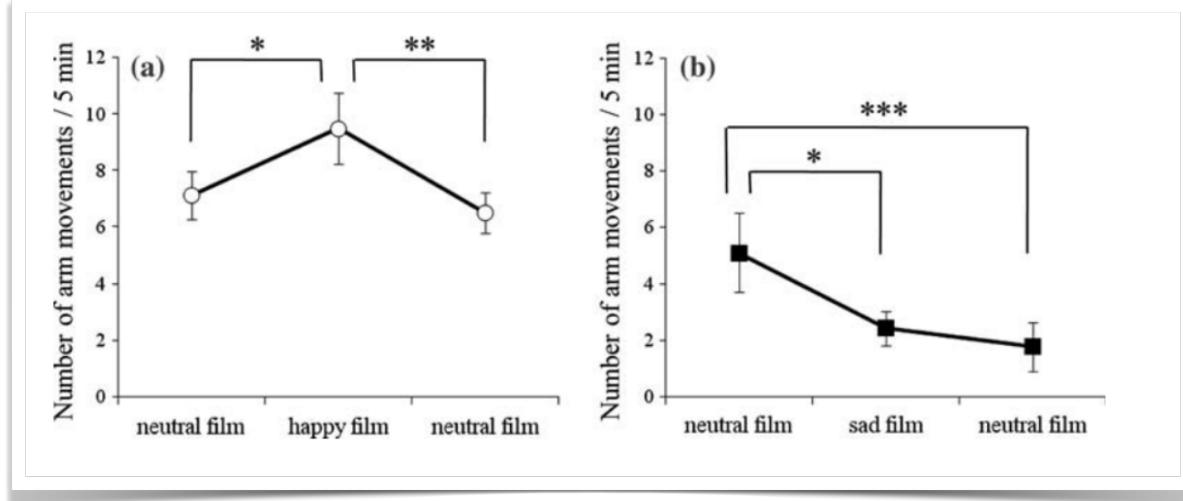


FIG.2 : The above graphs represent the results obtained from the research.

There is a substantial body of knowledge concerning the effects of long-lasting maternal emotional changes on fetal activity, that is, the association between maternal dispositional attributes and fetal behaviors. Ultrasound observations have revealed that more frequent movements were observed in the fetuses of mothers with relatively high anxiety with a significant positive correlation between the level of maternal anxiety and fetal movement. The fetuses of high-anger women were also reported to be more active, suggesting that long-lasting maternal negative feelings accelerate neonatal body movements.

However, it should be noted that fetuses of anxious mothers exhibited less body movement during active sleep. On the other hand, there have been few reports on the nature of fetal response *in situ* to acute maternal emotional changes. When mental stresses, possibly including negative emotions, were induced in pregnant women using

the Stroop Color and Word Test, fetal activity decreased consistent with the finding observed in the present study that the negative emotion of sadness decreased fetal activity. However, suppression of arm movement by sad film presentation did not return to the base line level during the next neutral film presentation. In the present study, we could not clarify that mechanism. Indeed the effectiveness of acute emotional induction is higher for negative than for positive mood. It is possible that this may be due to the fact that subjects usually enter the experiment in a rather positive mood and that such a positively biased mood is harder to enhance than to negate. Here, we demonstrated that positive and negative emotions exert opposite effects on fetal movements. However, what are the implications and consequences of the fetal arm movements? With regard to fetus development, fetal movement is one of five items used to assess fetal well-being, Decreased fetal movements predict oligoamnios, intrapartum fetal distress, low Apgar score, and meconium in the amniotic fluid.

It is worth noting that fetuses responded to maternal emotional changes that can occur in daily life, such as watching TV programs and movies.

It is possible that induced maternal emotions enhance sympathetic nervous system activity, which affects fetal activity by contracting the uterus; uterine contractions have been shown to decrease fetal movement.

Therefore, we conclude a physiological reaction of the fetus as an impact of emotional variations in the mother.

IV Intra-Uterine Stage : Emotional Variations

With the discovery of the human genome the majority of scientists came to the conclusion that humans are influenced entirely genetically. Today there are increasing arguments that much of our nature is due to our environment, which has extraordinary power to influence the genes. The fundamentals of such ideas are sustained by the latest research in the field of cell biology which shows that environmental stimuli control the gene activity.

Recent studies demonstrate the importance of intrauterine environment that trigger numerous mechanisms at the cellular level and lead to changes in the genome. The unborn-child has already vast information in the DNA sequences acquired from its parents and the drive to integrate new information with this pre-existing knowledge base. The DNA is passed on by the zygote to all subsequent divisions of cells, and so the knowledge contained in genes becomes available when they are stimulated or activated by signals from the environment.

Some authors show that it is not the cell nucleus but the membrane which has a fundamental role in adapting the organism to the environment and in adjusting the dynamics to an intracellular level, being sensitive to the environmental signals, controlling and regulating gene expression. Therefore, the perception of a new environment leads to the activation of a new group of genes, which in turn are able to create new proteins involved in cell perception providing appropriate responses. Once the environmental feature is recognized it is coupled with an appropriate behavioral response, thus the relation between input and output will be a program stored at the cellular level. The process itself has been called cellular learning and memory, and supports responses to the environmental signals sustain the optimization process in genetic development of the fetus .

Environmental influences also take place in some parts of the limbic system which became functionally at list on the half way through gestation, playing specific roles in storage and retrieval of survival memory as well as in emotional maternal contact . The prenatal emotional memory is related to the development of the amygdala, a brain structure involved in a wide range of normal behaviors and psychiatric conditions.

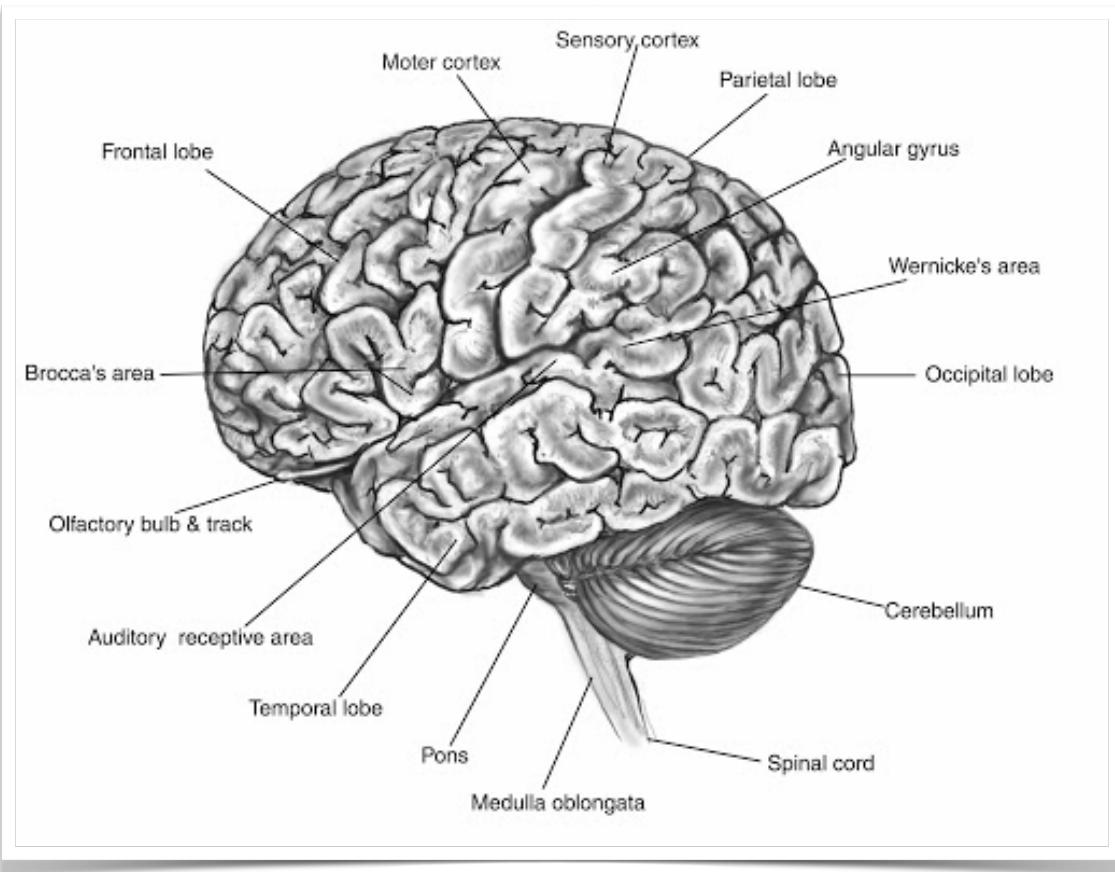


FIG.3 : The above Figure represents the Human Brain and classifies its parts

Mainly, amygdala is responsible for fear memory, storing contextual information and body movements that are associated with threatening situations in order to recognize them better later in life . In those particular situations the experience of the mother is strongly linked with the experience of the unborn baby, and contributes in the development of an informational deposit for certain kinds of situations perceived as threatening.

The biochemical messengers like neurotransmitters, hormones, peptides and neuropeptides have also an important role here. In this case neuropeptides are amino-acid compounds of the brain with an informative function, which are produced by nerve cells and hypothalamus and spread all over the body through its fluids. These amino-acid compounds seem to fit perfectly in cell s receptors that are located on the surface of certain cells in the body, including those of the immune system, endocrine system and the vegetative nervous system. This discovery enabled C. Pert to promote the idea of a psychosomatic network of communication , or the connection between mind and the body. D. Chamberlain concludes that this discovery forms a new basis for memory in

the first trimester of pregnancy, as the memory had in the scientific realm always been related merely to brain activity .

In addition to that, it is known that dopamine, serotonin and cortisol are neurotransmitters and hormones also linked with emotional states. Recent researches attest the relation between mother and the fetus emotional states in terms of biochemistry. Therefore, an important study [8] shows that depressed mothers tend to have newborns with the same biochemical profile: high level of cortisol, lower levels of dopamine and serotonin, greater relative right frontal EEG activation and lower vagal tone. Elevated maternal cortisol is the strongest predictor for the delay in prenatal growth, prematurity and low birth weight. Another study indicates that elevated stress levels reported by the mothers during the period from 12 to 22 weeks of pregnancy has to do with lots of outcomes for the baby, including greater likelihood of developing ADHD .

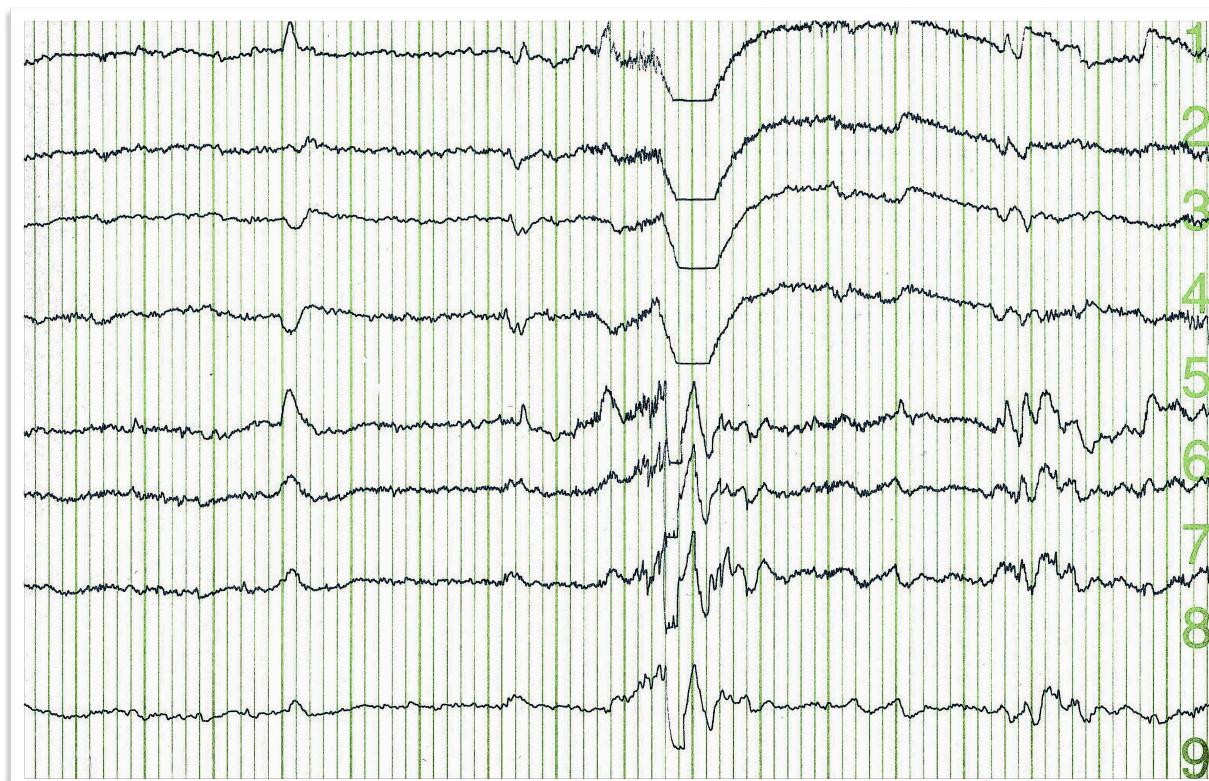


FIG.4 : The above graph represents results of activated EEG levels.

This perspective expands the role of in the development of the fetus, as mother's perception and reactions to what she perceives directly affect the selection of the gene programs of her offspring. Information is encoded in various forms, both neuronal and

cellular, which changes the older view. This could explain not only the existence of prenatal memory, but also the development of attitudes and the predispositions from this early period of human development. According to these findings the concept of memory is more complex. The discovery of the neuropeptides as substances with an informational character, epigenetic mechanisms and complementary neural networks, throws a new light on the question of the fetal mind. Thus, the emotional pattern is set and the unborn baby has a preview of life and of the environment in which will soon emerge.

The prenatal period has great importance because of the lasting presence of fetal memory influenced by the mother emotions, her perception of the environment and other factors. Those prenatal memories due to positive, lack of or damaged bonding with the unborn baby are the basis for human attachment, which along with other postnatal factors give shape to the emotional patterns in relation to the outer world.

Our approach has an important limitation due to the fact that it did not take into account the role of the father in relation with the pregnancy of his partner, and for this reason further researches has to be done. The development of a child is a dynamic and interactive process between parents: the interaction between the parents, maternal response to the environment, prenatal bonding, and perceptions experienced.

V Post-Natal Stage : Physiological Variations

The human brainstem is almost fully functional at birth whereas the limbic forebrain is more plastic, "experience-expectant," and slower to mature and develop. Whereas the brainstem mediates reflexive motor and vital functions, the limbic forebrain (e.g. the hypothalamus, amygdala, septal nucleus, cingulate, and hippocampus) monitors and attempts to satisfy hunger and thirst and is responsible for the experience and expression of emotions including pleasure, rage, fear and joy and the desire for social-emotional contact.

Unlike the brainstem which is more "hard wired" and initially under direct genetic and reflexive sensory control, limbic system nuclei, such as the amygdala, septal nuclei and hippocampus, as well as the later to mature neocortex, require considerable social, emotional, perceptual, and cognitive stimulation during the first several months and years of life in order to develop normally. If sufficient stimulation is not provided, or if exposed to an abnormal or neglectful environment, developing neurons and dendrites will establish or maintain aberrant, abnormal interconnections, or whither, die, and drop out at an accelerated rate.

Initially billions of neurons, dendrites and synaptic interconnections are produced in random excess. Over the first several years and decade of life, these excess neurons are pruned and sheared away by the hundreds of millions. It is through dendritic attrition that specific neural networks are sculpted and formed. The sculpting of specific neural pathways fine tunes perception, selective attention, and promotes learning, memory, and cognitive and personality development. However, if reared in an abnormal, deprived and socially isolated environment, limbic system nuclei will atrophy, random interconnections will be maintained, or neural pathways will develop abnormally .Neurons, dendrites and interconnections that would normally survive are significantly reduced throughout the brain. There is an accelerated loss of presynaptic vesicles, glia, interneurons, neurons, axons, synapses, and cortical thickness, and the septal nuclei, amygdala and hippocampus may develop seizure-like activity.

An abnormal or impoverished rearing environment can decrease a thousand fold the number of synapses per axon, and retard the growth and eliminate billions if not trillions of synapses per brain and result in the preservation of abnormal interconnections which are normally discarded over the course of development.

Because the brain's developmental journey does not cease at birth early environmental influences can determine the establishment of specific neural networks, or can lead to the creation and maintenance of aberrant or random neural pathways thus interfering with the forebrain's ability to discretely, purposefully, and selectively maintain control over behavior.

Hence, in summary, early social, emotional and environmental influences exert significant organizing effects not only on the brain but shape and mold all aspects of intellectual, perceptual, and social and emotional development.

LIMBIC SYSTEM - SOCIO-EMOTIONAL DEVELOPMENT

As is now well established, the limbic system provides the foundation for all aspects of social and emotional behavior.

However, limbic system nuclei, such as the amygdala, septal nuclei, and cingulate gyrus, play different roles in social and emotional development. They also mature at different time periods. As first discovered and detailed by Joseph, different phases of social emotional development and the formation of loving attachments correspond to the differential maturation rates of the amygdala, septal nuclei, and cingulate gyrus; a developmental process that also involves the orbital frontal lobes. The orbital frontal lobes are an evolutionary derivative of the amygdala and cingulate, and remain quite plastic for the first several years and even decades of life.

The differential maturational rates of these limbic nuclei, beginning with the development of the amygdala and followed by the cingulate and septal nuclei, enables humans and other higher mammals to first socialize indiscriminately, to slowly develop stable and selective loving attachments, and, around six months to one year of age, to express and experience emotions such as anger, joy, and fear of strangers.

For example, the medial amygdala rapidly develops and completes its myelogenetic cycle of maturational development by the end of the first postnatal year.²

It is the immature amygdala which is responsible for the extreme orality and indiscriminate socializing of the infant; interaction which it requires in order to mature normally.

As fear and wariness are hallmarks of amygdala activity , it is the continued maturation of this nucleus which is also responsible for the experience of wariness and then a fear of strangers. Although somewhat slower to develop, the cingulate gyrus also reaches an advanced stage of maturity during the first year, but continues to develop over the course of the next several years. The cingulate gyrus, being intimately associated with the amygdala and or By contrast, the septal nuclei undergoes a more protracted rate of development and does not begin to reach adult levels until three years of age; a process of development which actually continues well into puberty.

However, between the ages of one and three, as it begins to mature, the septal nuclei inhibits and counters the indiscriminate social desires of the amygdala and contributes to a narrowing of social contact seeking and the generation of wariness of strangers.

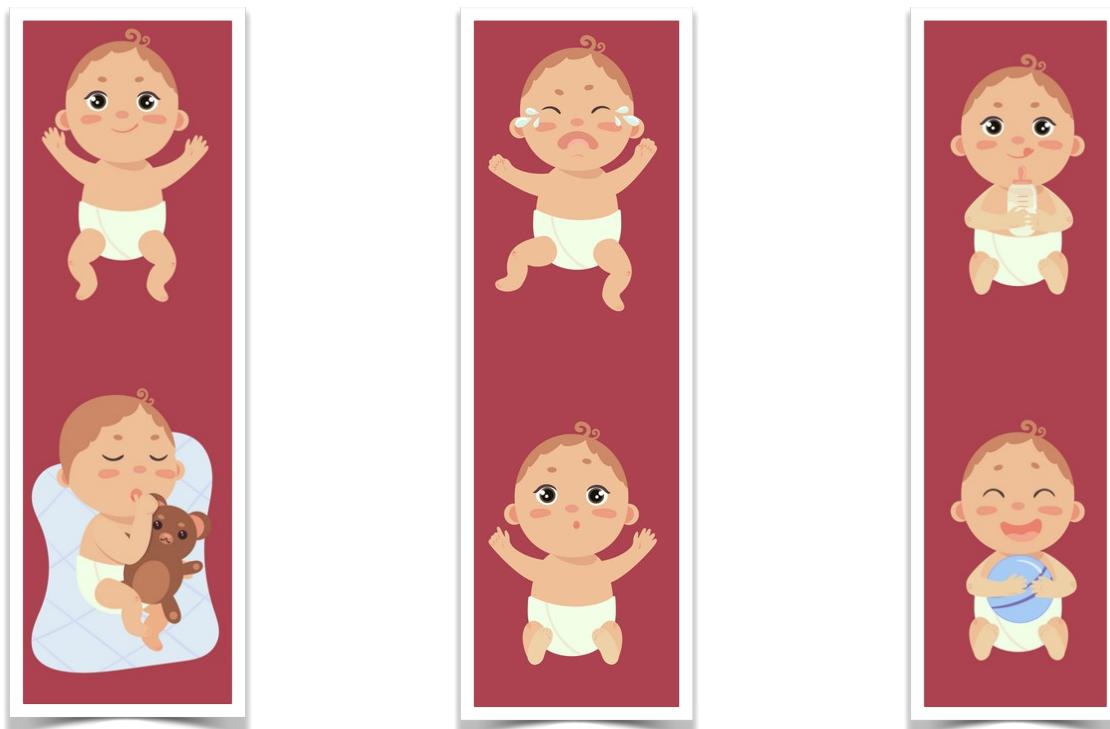
VI Post-Natal Stage : Emotional Variations

Post-natal stage denotes the period after childbirth and mainly comprises of infancy. Infants are born with very raw and powerful emotions. Infants are very social beings that develop emotionally through the relationships they have. A child's earliest relationships and experiences play an important part in their later development. Supporting a infant's emotional development is just as important as looking after their physical needs.

At first, a infant develops emotionally and physically from having all their needs met. A infant struggles with any delay and needs a quick response. Security comes from not having to wait too long to be comforted, fed or held. As infant grows they will start to learn who their special people are and can be worried by new faces and situations. The way they are held, soothed and introduced to the world are very important in developing feelings of safety and security.

During infancy, infants display a range of emotions in social situations through a non-verbal message. Then, advances in cognitive development allows infants to identify their own and other's emotions. This emotional understanding, forms the foundation of strong emotional intelligence in later stages of life.

This section analyses the factors and emotional responses in infants that contribute to better emotional intelligence in life.



At birth, infants exhibit two emotional responses: attraction and withdrawal. Approach behavior or attraction can be observed in first month of life and become more elaborated as development advances.

They show attraction to pleasant situations that bring comfort, stimulation, and pleasure. And they withdraw from unpleasant stimulation such as bitter flavours or physical discomfort. At around two months, infants exhibit social engagement in the form of social smiling as they respond with smiles to those who engage their positive attention. Pleasure is expressed as laughter at 3 to 5 months of age, and displeasure becomes more specific to fear, sadness, or anger in later stage. Where anger is a healthy response to frustration, sadness, which appears in the first months as well, usually indicates withdrawal.

The evidence to stated points can be given as: infants turn their head or shut their eyes. They become fuzzy or cry loud depending upon the certain stimulation they perceive. Learning to self-regulate is a key milestone in child development – whose foundations are laid in the earliest years of life. A child's capacity to regulate their emotions affects their family and peers, academic performance, long-term mental health, and their ability to thrive in a complex world.

A child who cannot self regulate and throws tantrums constantly puts a strain on the parent-child relationship. This can impact the climate of the whole household, including siblings or everyone around them, and lead to a negative spiral. Infants who have learned to regulate their emotions can also better handle and bounce back from trauma or adversity: They have a higher distress tolerance and more resilience.

These two emotional response are very crucial. Aspects of attraction and withdrawal that essentially deal with the directional and arousal characteristics of infant responses leads to:

1. Exploratory Behavior
2. Curiosity
3. Intrinsic Motivation
4. Resilience

Stranger Wariness and Stranger anxiety

As infant moves towards the horizon of good emotional response of attraction and withdrawal, emotional variations in terms of stranger wariness and stranger anxiety build in.

As an infant's memory develops, they are able to separate the people that they know from the people that they do not. The same cognitive advances allow infants to respond positively to familiar people and recognize those that are not familiar.

Stranger wariness actually indicates that brain development and increased cognitive abilities have taken place. The same cognitive advances allow infants to respond positively to familiar people and recognize those that are not familiar.



Separation anxiety also indicates cognitive advances and is universal across cultures. Due to the infant's increased cognitive skills, they are able to ask reasonable questions

like "Where is my caregiver going?" "Why are they leaving?" or "Will they come back?" Separation anxiety usually begins around 7-8 months and peaks around 14 months, and then decreases.

Both stranger wariness and separation anxiety represent important emotional development because they not only reflect cognitive advances but also growing social and emotional bonds between



infants and their caregivers.

This emotional response sets the stage whom to trust and whom to mistrust. It creates the environment to learn co-operation and sharing emotions together. This further leads to attachment emotional response of infants.

Attachment

In addition to rapid physical growth, young children also exhibit significant development of their cognitive abilities, particularly in language acquisition and in the ability to think and reason. Piaget's theory of cognitive development, and in this section, we'll apply that model to cognitive tasks during infancy and toddlerhood. Piaget described intelligence in infancy as sensorimotor or based on direct, physical contact where infants use senses and motor skills to taste, feel, pound, push, hear, and move in order to experience the world. These basic motor and sensory abilities provide the foundation for the cognitive skills that will emerge during the subsequent stages of cognitive development. Piaget believed that children take an active role in the learning process, acting much like little scientists as they perform experiments, make observations, and learn about the world. As kids interact with the world around them, they continually add new knowledge, build upon existing knowledge, and adapt previously held ideas to accommodate new information. Children have much more of a challenge in maintaining this balance because they are constantly being confronted with new situations, new words, new objects, etc. All this new information needs to be organized, and a framework for organizing information is referred to as a schema. Children develop schemas through the processes of assimilation and accommodation.

In emotional development, forming healthy attachments is very important and is the major social milestone of infancy. Attachment is a long-standing connection or bond with others. Developmental psychologists are interested in how infants reach this milestone.

The evidence to support attachment in infancy can be stated using separation anxiety. When parents or primary care-giver go away, infants start crying. This is what we call separation anxiety.

The central theme of attachment is that the primary caregiver who are available who are available and responsive to an infant's need allow the infant to develop a sense of security.

Awareness

All the emotional responses, forms the base to form a awareness, which is imperative for emotional intelligence. As development of infants proceeds infants. During the later infancy, children begin to recognize themselves as they gain a sense of the self as an object. The realization that one's body, mind, and activities are distinct from those of other people is known as self-awareness.

The realization of one's body, mind and activities that make them distinct from others embarks from here. The evidence is rouge test.

This test as mirror self recognition test which may offer clues about the development of awareness. Without alerting the child a mark is placed on its forehead. Usually, infant younger than 6 months doesn't make the connection between itself and person the mirror. The child may look behind the mirror as well. But around 12th month of life, there is a change in the child's awareness.

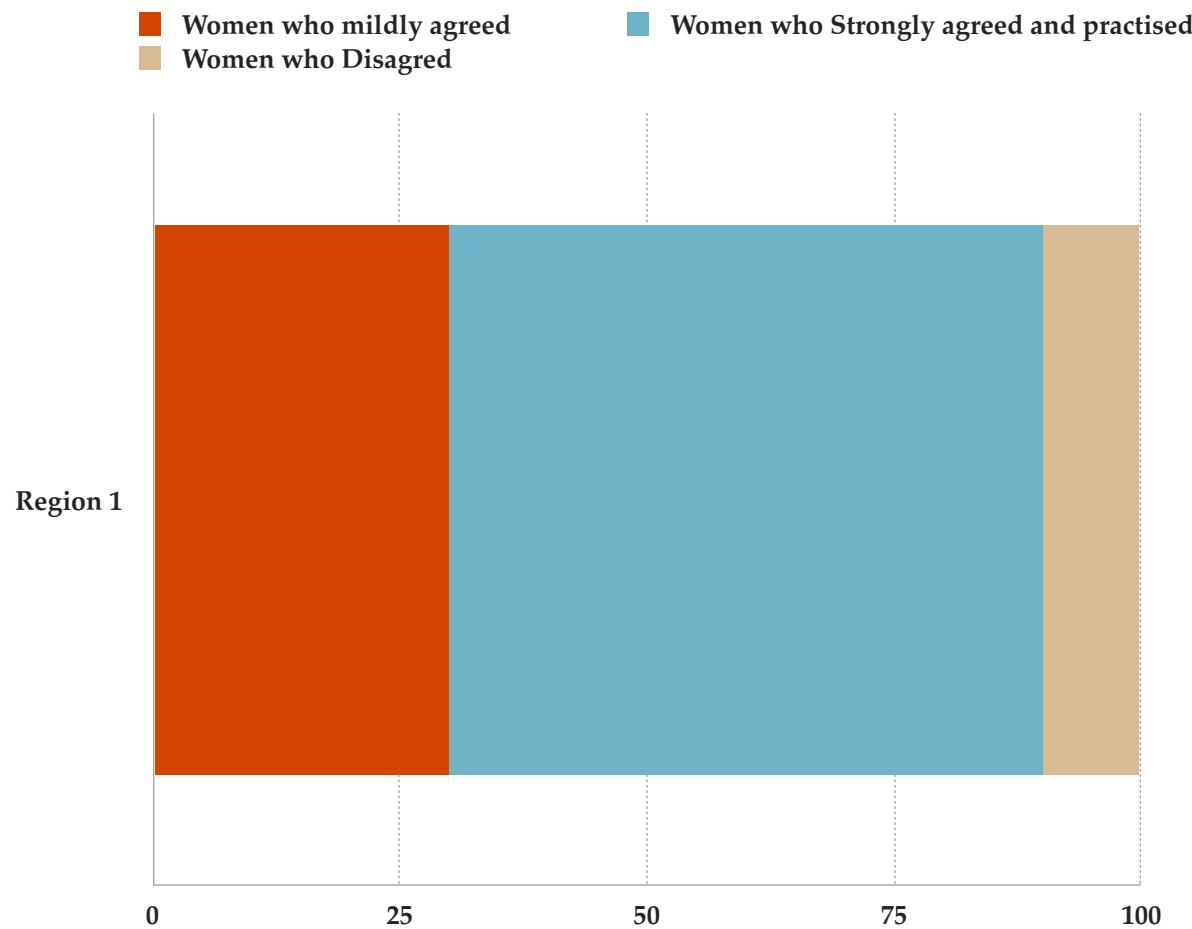
Moving Towards Conclusion

Once a child has achieved awareness, the child is moving toward understanding social emotions such as guilt, shame or embarrassment, and pride, as well as sympathy and empathy. The emotional responses during infancy, offers an explanation of how we develop a social sense of self. There are two parts of the self: the "I" which is the part of the self that is spontaneous, creative, innate, and is not concerned with how others view us and the "me" or the social definition of who we are. When we are born, we are all "I" and act without concern about how others view us. But the socialized self begins when we are able to consider how one important person views us. It leads to interpretation, processing, channelizing and recognizing emotions . Apart from these, genetic, upbringing and environment factors, all play a vital role in development of strong emotional intelligence.

SURVEY RESULTS

Now, let's look at some stats.

We prepared a set of 10 questions related to our topic on Google Forms and circulated it among our relatives, majorly targeting mother-to-be audience.



As a result we received 15 responses out of which 11 of them were expecting mother's. Therefore, we consolidated the data into the following pie chart by contracting it approximately.

We observed that approximately 60% of them, Strongly Agreed to the concepts of pre-natal and post-natal development and practiced them.

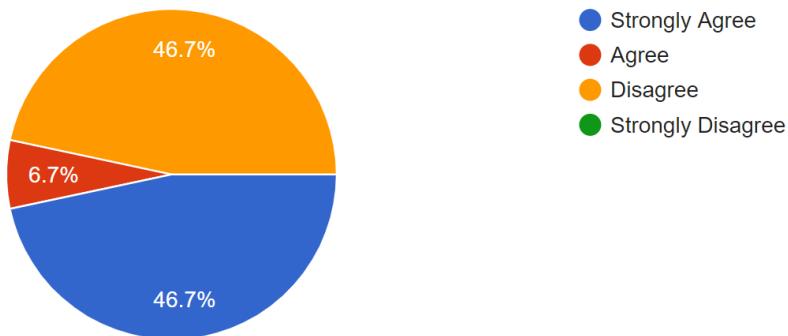
While 30% of them were hesitant in practicing them practically, while they all along knew about it. 10% of them mildly disagreed, that means, they weren't aware of them.

We also included a parameter of employment, that significantly impacted the responses of the audience as well as for the Emotional Development Awareness.

Following is the list of Questionnaire that was inculcated in the Survey form :

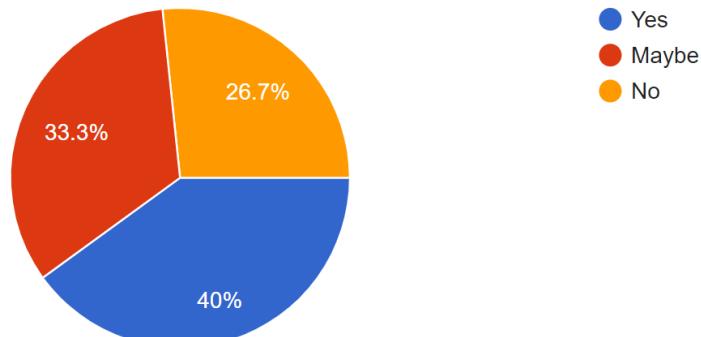
- 1.) Have you experienced physiological reaction of the fetus with variation in your Emotional State?

15 responses



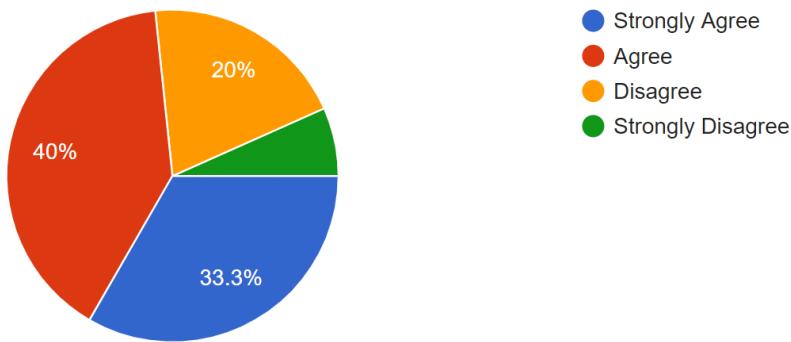
- 2.) Are you aware of the Pre-Natal Developmental steps?

15 responses



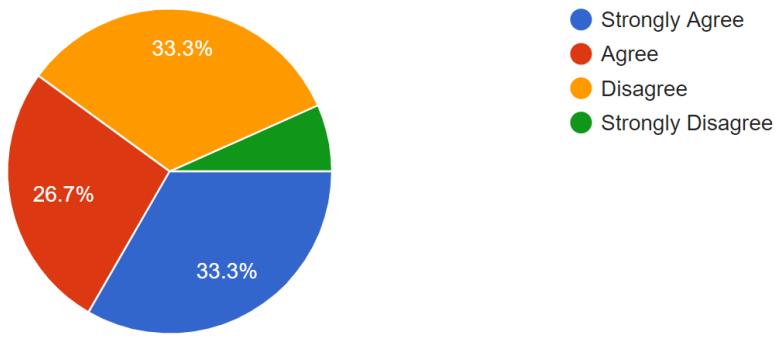
4.) Do you do something special to stimulate the infant's brain?

15 responses



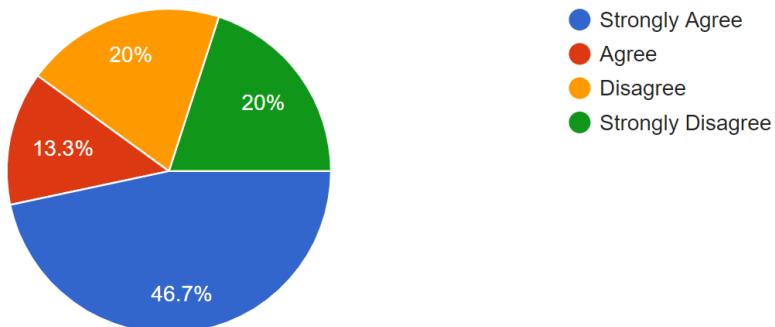
5.) Do you acknowledge and verbalize the infant's emotions?

15 responses



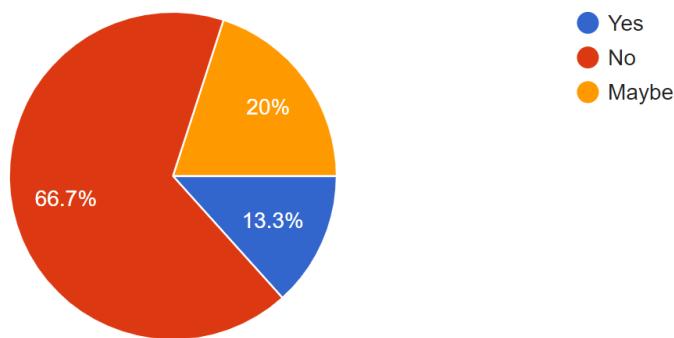
6.) Do you consistently regulate your emotions as a reaction to that of infant?

15 responses



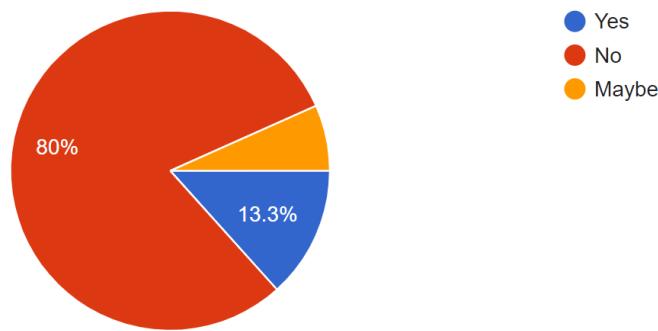
7.) Are you aware 'Rouge Test' ?

15 responses



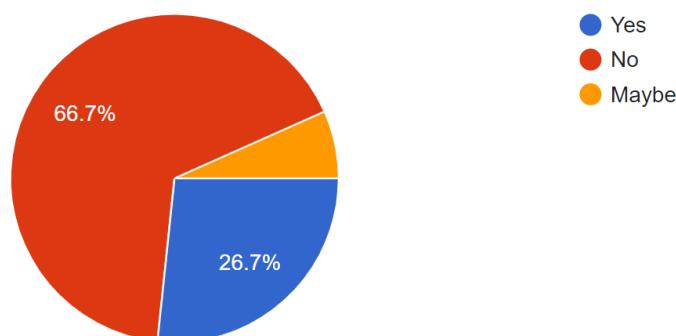
8.) If yes, then have you ever practiced it?

15 responses



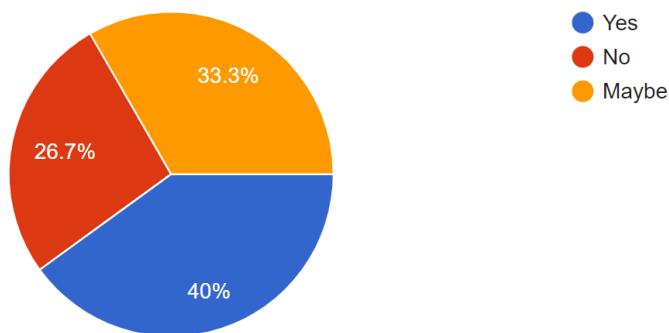
9.) Are you technically aware of Fetal Programming, a part of infant development.

15 responses



Since, for every trait, nature and nurture interact, do you keep a track record of the temperament of your infant?

15 responses



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