SRYAHWA PUBLICATIONS

Archives of Pediatrics and Neonatology
ISSN: 2638-5155 | Volume 7, Issue 1, 2024
https://doi.org/10.22259/2638-5155.0701002

RESEARCH ARTICLE

Intellectual Stimulation in Utero Should Be One of the Most Important Concerns

Zygmunt Leonidas Ostrowski*

European Association for Child Development (ADE), Hôpital Armand Trousseau, Paris, France

Received: 13 June 2024 Accepted: 26 June 2024 Published: 19 July 2024

Corresponding Author: Dr. Zygmunt Leonidas Ostrowski, European Association for Child Development (ADE), Hôpital Armand Trousseau, Paris, France.

Abstract

In utero, the maturation of the brain begins very early with the establishment of connections between neurons. The synapses, which will define the baby's intellectual potential, unfortunately receive little stimulation in utero. If we put more of a strain on the brain, the number of synapses increases. In addition, with the very rapid development of the brain, several sensory functions are already available to receive information. Numerous reports indicate that babies in utero recognize and memorize emotions and may be conscious. This aims of this paper is to present the meaning of intellectual stimulation, which in fact begins before birth, and how to stimulate babies in utero by different methods: direct and indirect. Since pregnant women emotions can have an impact on babies' intellectual stimulation, all means to increase these emotions may be advised. Aside sound stimulation, haptonomy and different activities like working on the mother's memory through certain intellectual activities such as reading, painting, or embroidery, according to mother's abilities and possibilities, but more complicated or difficult, that require additional mental effort. Intellectual stimulation at the earliest stages of life should be one of the most important concerns of health professionals in maternity and neonatology. It should be as well a fundamental problem of states and international organizations in the field of human health and well-being, in the so-called well-being of MAN, as well as in education.

Keywords: Fetus, Intellectual Stimulation, Emotions, Conscience, Chromosome, Sounds, Touching.

1. Introduction

Recent research on brain development in the uterus increased our knowledge about maturation and memorization. The international colloquium on intellectual stimulation at the very beginning of life, organised by A.D.E. [1], under the auspices of UNESCO in Paris (1989), showed that consideration of intellectual development is important because it also concerns the period before birth. Since "… the greatest and subtlest qualities of the human mind lie in its capacity to think and reason, that is, in its intellect" [2], the period of prenatal development is extremely important for the future development of the child.

Unfortunately, it is the period about which we know the least. Only studies in later fetal life could be conducted in infants born prematurely, assuming that these babies developed before birth, would develop after birth in exactly the same way as babies who remain in the womb for the average duration of pregnancy [3].

Recent studies showed that the child's intelligence is not only transmitted through the mother because the genes for intelligence come from the X chromosome. To help to develop the intellectual stimulation as early as possible, which in fact begins before birth is the aim of this study. Today, we have enough data and observations that babies in utero memorize and that stimulation before birth has the effect of faster intellectual development of the child. It is then necessary to draw attention to the fact that intellectual stimulation at the earliest stages of life should be one of the most important concerns of health professionals, WHO, UNESCO, and UNICEF.

Citation: Dr. Zygmunt Leonidas Ostrowski, Intellectual Stimulation in Utero Should Be One of the Most Important Concerns. Archives of Pediatrics and Neonatology. 2024;7(1): 06-12.

2. The Brain

Brain maturation begins in a strictly programmed way, in the first month of embryonic development in utero, between the 19 and 28 days. The first synapses begin forming in the fetus's spinal cord and by the sixth week, these early neural connections permit the first fetal movements that researchers can detect through ultrasound imaging. After the neuron production is practically completed, the glial cell production continues until the end of pregnancy [4].

The maximum number of neurons remaining in the fetus depends on the neurons or group of neurons that establish the sufficient number of connections [5]. From the eighth month of pregnancy, the number of neurons and synapses decreases. These neurons atrophy and die is a normal physiological process. In some cases, it is because they have performed vital functions and are no longer needed, in others it is because they are superfluous and have not been stimulated enough to make connections.

By stimulating different sensory systems of the fetus, one can reduce the removal of neurons and increase the number of connections [6]. The brain takes control of bodily functions already in the second trimester. Then, the brain splits into two halves, right and left, and continues to grow. Under the influence of external stimuli, a stable network already operates in the initial phase of the installation. The stabilized phase probably occurs in the last trimester of pregnancy.

Memories are thought to be stored in the connections between neurons called synapses. Every new memory changes the synapse strengths, which in turn alters previously stored memories. Synaptic plasticity is thought to be the basis of learning and memory [7].

According to Curzi-Dascalova [8], several data support the hypothesis that restless sleep (which appear as early as the sixth month of pregnancy (28 weeks)is essential for the integration of information. Observations of fetal behavior using ultrasound show that both stages of sleep exist in utero, with a clear predominance of time spent in restless sleep.

In the opinion of Howard Roffwarg [9], paradoxical sleep (REM) may play a role in brain development and maturation. It corresponds to 20% of total sleep time. During this phase, brain activity is very intense. It's a phase in which we dream a lot. Sensations during active sleep are generated in the right cerebral hemisphere, and during slow sleep they are generated in the left cerebral hemisphere.

2.1. Emotions

Emotions are thoughts which are dependent on certain activities in regions of the brain who manage our attention. It is the limbic system that is the center of emotions and memory. Higher cognitive functions who concern perception, conscious thought, language and long-term reasoning are situated in the neocortex. In utero, baby's development takes place on a physical level, but also on an emotional level. The baby has a special bond with its mother and lives in total communion with her. According to Alban Lemasson[1] and Martine Hausberger[2], the fetus is capable of feeling its mother's emotions, whether they are positive or negative.

When stressed, the mother's body releases cortisol. Scientists have established that cortisol crosses the placental barrier and can be found in significant amounts in the amniotic fluid. As a result of its presence, the fetus's heart rate is likely to slow down. It is possible that prolonged exposure to maternal stress can have consequences on the baby's development and impact of his future life. Sensory stimuli and the emotional state of the mother therefore have a crucial impact on the fetus and then on the child's future behavior and character. According to Catherine Gueguen[3] , infants have a bond with their mother and are immersed in her emotions. Today, we have data on early emotion imprinting, biological memory, and its effects on child development. Their sensitivity should not be underestimated, as a child's learning and social connections are directly related to their emotional capacity.

It's known that emotions already play a role in utero. This sudden and intense internal reaction runs through the body and mind. It responds to a stimulus and a cause, specific to the baby. According to a study conducted by two researchers from the University of Rennes, there is evidence that the mother's emotions and psychological state play a major role in the baby's evolutionary process. In utero, the developing fetus learns about the outside world and shapes itself through this bond woven from the moment of conception. The baby is extremely receptive to his mother's behavior, tastes, sounds and emotions. He smiles when he perceives a pleasant taste. He can hear and recognize the sound of his mother's voice; but also, the feelings

1. Teachers and researcher at the Laboratory of Animal and Human Ethnology (EthoS).
2. Director of the CNRS laboratory in Rennes.
3. French pediatrician and author of numerous essays on education and neuroscience.

of a mother who has experienced a stressful life event during pregnancy. Few studies have even found a link between stressful or very exciting life before conception events (PSLEs) [10]. All sensory stimuli and the emotional state of the mother therefore have a decisive impact on the fetus and then on the child's future behaviors and character. Thanks to a French study published by The Conversation, conducted by two researchers from the University of Rennes, proof is provided that the emotions and psychological state of the mother have a preponderant role in the baby's evolutionary process.

2.2. Conscience

Some scientists have only recently shed light on the mystery of infantile consciousnes[4]. Neuroscientists from the University of Tübingen in Germany, Trinity College Dublin in Ireland, the University of Minnesota in the United States, and Monash University in Australia, conducted a literature review on prenatal and neonatal consciousness. They determined a trend toward an awakening that already occurs during the last month of pregnancy.

According to Tim Bayne et al., [11] □... Some theorists suggest that consciousness requires cognitive abilities that are likely to appear even as early as the gestational age of 24 to 26 weeks, which is when thalamocortical connectivity is first established. Preterm infants and fetuses of equivalent age share some common patterns of cortical activity and both have remarkable learning abilities. Given the difficulties of in utero imaging and the relative ease with which preterm infants can be studied."

In the 25th week, the fetus begins to recognize certain elements or situations: it has a certain awareness of our presence. In the 27th week, some researchers claim that at this stage of development, the fetus is already dreaming. Beta or REM brain waves, which are fast and of low amplitude, have been detected.

They are associated with the REM sleep phase. "Since infants and fetuses spend much of each day in rapid eye movement sleep, it's not clear if they're dreaming. If we think of dreams as simulations of reality, we might ask what earlier model of the world the child, with his very limited experience, could rely on to generate the dream content. This becomes even more relevant when we ask the question of newborns or fetuses," concludes Tim Bayne.

2.3. Sound Stimuli

The fetus hears in the womb; it is immersed in a permanent sound environment. It perceives the vibrations of sounds from the bones of his skull and the maternal pelvis which act as resonators. Thus, from the 7th week of pregnancy, the vibrations of the music or the various sounds perceived give the child his first emotions. Already between the 5th and 8th month of pregnancy the fetus has the ability to record perceived sounds. In the uterus, the fetus's emotions increase tenfold when it hears music.

The fetus perceives its mother's drive state through the rhythmic vocal expressions of its speech (DeCasper& Spence, 1986; Fifer and Moon, 1995; Hepper, 1995; Lecanuet, 1996). The maternal voice is perceived more intensely because it brings the body into vibrations. Voices are de-timbered, because the absorption of external sounds is such that low sounds are not absorbed and High-pitched sounds lose about 30 decibels, causing the timbre to change.

On the other hand, the intonation persists since it is below 800 Hertz (it is a frequency well transmitted in utero [12]. The baby hears sounds, but the mother's voice, as well as external voices, is changed. The sound recognition rate is only about 30%. High-pitched sounds are less well perceived since it is filtered by the mother's amniotic fluid and abdominal wall. Low pitches are transmitted better through the hearing already from weeks 19–20 of pregnancy.

Music is therefore an essential pillar of development that allows the baby to awaken and to develop its intellectual capacities... [13]. It is known that the fetus has different reactions depending on the type of music. For example, it calms down with Mozart, and becomes agitated while listening to rock music [14]. Since the fetus associates sounds and emotions and memories of them, it is important to stimulate them by all means.

Thus, the more the brain is stimulated, the more the connections between neurons persist. Babies are found to remember the sounds they heard and experienced in the womb [15]. To test the hypothesis that foetal memory persists into the neonatal period, 41 newborns were repeatedly stimulated by using fetal vibro-acoustic stimulation and were compared with 31 controls. The newborns who were stimulated in utero habituated earlier than those who had not previously experienced stimulation [16]. These results suggest that the fetuses were able to learn.

4 Consciousness is the constant and immediate presence of self to self. It is the reflexive faculty of the human mind, that is, its ability to look back on itself. It is consciousness which enables man to take himself as an object of thought. Consciousness needs the words of language to structure itself. Thought, on the other hand, emerges between words, it includes intuition, the unspoken, the ineffable.

2.4. Touch

Touch is the psychic organizer of the human being, the sense in which the sense of the unity of the self develops. Touch is the first sense that develops in the fetus, long before hearing. Some touch receptors appear as early as the 4th week of pregnancy. Around the 7th week, touch receptors are present on the fetus's mouth: the fetus moves when something touches its lips. Later, around 11 weeks, touch receptors are present on his face, the palms of his hands, and the soles of his feet. In the womb, the fetus is exposed to several tactile sensations. He moves in all directions and likes to snuggle and rub his nose against the wall of the amniotic sac. He also sucks his thumb and plays with his umbilical cord or with his feet.

Developed by Dutch scientist Frans Veldman [17], haptonomy is a technique that focuses primarily on touch and offers future parents the opportunity to get in touch with their baby in utero through touch. Touching and caressing by parents are very important for developing attachment and a sense of security in the baby. The physical presence of his parents stimulates his immune and hormonal system.

This has a positive effect on their growth and attachment hormone levels, while also decreasing their stress hormone levels [18]. Tiffany Field [19], said "…that the new Touch Research Institute at the University of Miami School of Medicine, is the first of its kind in the world for touch and skin. So, although the skin is the largest sensory organ in the body, it has been the most neglected research topic." According to Field, touch is especially important for fetal growth and development.

Why does touching have this effect? Apparently, touch stimulates brain chemicals that are crucial for growth. Saul Schanberg and his associates [20] at Duke University demonstrated this with pups (newborn rats). Stress releases painkillers called endorphins from the human nervous system. Endorphins inhibit the production of ornithine decarboxylase (ODC), the brain hormone that stimulates growth.

2.4.1. Skin

According to Dominique Cupa [21], "... The skin is the source, the place and the model of pleasure." As the first interface with the outside world, it remembers what is reassuring or what is suffering. It keeps the information of all contacts. Our epidermis seems to have its own language, responsible for relaying all the unspoken things in our lives. There is an interaction between the brain and the skin because both have the same embryological origin, they are formed on the twenty-first day of the embryo's development. Baby's skin forms in the 1st month. The embryo is covered with a layer of flat cells (epidermis) and six months later, the nerve pathways that connect the skin to the spinal cord are established.

The discoveries of these astonishing connections between skin and brain are very recent. The skin receives, the skin transmits, the skin vibrates and the skin lives. Skin reflects our emotions. The psychoanalyst Didier Anzieu, who wrote "Le Moi-Peau" in 1974 [22], is convinced of that touching and letting oneself be touched is a source of psychic and bodily vitalization [23]. In utero, the developing fetus learns about the outside world and shapes itself through this bond woven from the moment of conception.

2.5. Intelligence

We know that the learning process begins in utero. The fetus memorizes its prenatal experience and external stimuli. Intelligence is characterized through logic and the ability to use language to express one's thoughts and to understand others, as well as there are six other forms of intelligence. Spatial intelligence: from the 12th week of pregnancy, the fetus moves in reaction to stimuli, it is aware of the amniotic environment in which it moves with agility.

Musical intelligence: the fetus has different reactions depending on the type of music. Body intelligence: the fetus controls its body and movements. Intrapersonal intelligence: the fetus has the ability to understand its own personal emotions, he may smile when he perceives a pleasant taste. Interpersonal intelligence: the fetus develops an ability to bond with the twin. Logical intelligence: the fetus responds with the same number of kicks if we give its mother few small taps on her belly.

Is the child's intelligence transmitted only through the mother because the genes for intelligence come from the X chromosome? According to an American scientific study [24] this possibility is due to the fact that women have two X chromosomes who are more likely (than men's one X chromosome) to influence their children's cognitive abilities. Jessica Delgado [25] added that "… in the embryo, certain genes that play an important role in brain development are only active if they are found on a chromosome from the mother". Also, Lehrke [26] said, that the genes influencing cognitive abilities (memorization, language, attention, reasoning faculties, etc.) were all located on the X sex chromosome.

But Professor Nicolas Pilon[5] described that a similar phenomenon exists in genes that have a paternal X chromosome. Also, other scientists[6] reveals that the father influences many aspects of cognitive development. Some scientists agree that the mother's genes, like the father's, play an essential role in the development of a child's brain, but it's really the interaction between the genes and the environment that makes all the difference.

Professor Michael R. Johnson and al. [27] of Imperial College London showed that "…genetics plays a role in intelligence, but we didn't know which ones were involved in our cognitive performance or to what extent they interacted with each other. Probably it is possible to develop others through stimulation and exercises." Michael R. Johnson [28] added that "… maternal genetic fingerprinting does influence a child's brain development, but no more so than a father's. For this reason, intelligence is not defined solely by the X chromosome.

The research has shown that our cognitive abilities depend on two important networks of genes, M1 and M3, which together contain nearly 1,200 genes". Genetics plays a role in intelligence, but until now we didn't know which genes were involved, concluded Professor Johnson. According to Howard Gardner [29], intellectual improvement requires the development of skills that already exist at the very beginning of life.

3. Result

The observations allowed us to suggest that intellectual stimulation should be included in maternal care programs already in the first months of pregnancy. Although we do not yet have scientific evidence for the effects of intellectual stimulation in the prenatal period, but we have enough observations that stimulation before birth has the effect of faster intellectual development of the child in utero. It can be stimulated from the first weeks of pregnancy, either directly or indirectly. It is known that it responds to sounds and vibrations very early and that it feels the taste of the third month of foetal life.

Sounds and light touches aren't the only things that come with fetal learning. Sensory buds are fully developed around seven months of gestation with fully functional olfactory receptors. The food that the pregnant mother eats passes into the amniotic fluid, which is in turn absorbed by the fetus. Olfaction, an important sense of fetal life, since the fetus perceives its mother's scent contained in the amniotic fluid. The baby perceives four primary flefors: salty, sweet, sour, bitter. It's also known that it reacts emotionally to the touch of any area of the mother's skin, but also through the emotional state of the mother herself.

4. Discussion

During months spent in the mother's womb, the fetus perceives sensations and emotions from its mother that it can even remember them after birth. Since any additional stimulation can be a chance for its further development, there are several ways of stimulation, observed both in the environment of the average population of European civilization but, especially in the environment of a population still living in poor conditions and without education.

It's known that malnutrition during pregnancy has little effect on the development of the brain and intellectual performance of the baby (iodine deficiency is an exception). In utero, malnutrition surely plays a role, but there is protection, because it is the mother who, even malnourished, makes a fee.

Only severe malnutrition can have an impact on the fetus and his development. Personal observations of the African population in southern Sudan (1979-1984), of the traditional population on the island of Zamboanga in the Philippines (1986) and of the agricultural population in China (1987), far from Shanghai, allowed to develop several stimulation schemes. Directly by sounds, vibrations, singing and music (especially by the voices of men), and by touching mother's skin. Aside sound stimulation and haptonomy, also other activities may have an impact on babies.

Indirectly, working on the mother's memory through certain intellectual activities may have an impact on babies' intellectual stimulation. Reading, painting, or embroidery, according to the mother's abilities and possibilities, but more complicated or difficult, that require additional mental effort. The type of stimulation should be individualized. Often repetition of different stimulation is advised. Beyond intellectual stimulation, the effectiveness of stimulating babies' senses in utero remains the best way to give him the feeling of well-being and serenity. By developing the child's cognitive abilities, it significantly increases his/her IQ. Of course, further studies would be desirable to confirm the impact of intellectual stimulation in utero.

5. Nicolas Pilon, Associate Professor, Department of Biological Sciences, UQAM.
6. Jacinta Bronte-Tinkew, Rebekah Levine Coley, and Alyssa S. Meuwissen

5. Conclusion

In utero, baby's development takes place on a physical level, but also on an emotional level. Since few decades, research on brain development in the uterus increased our knowledge about maturation and memorization. There are many indications of a kind of prenatal memorization.

This memorization relates to the recognition of perceived intonations in the placenta. The fetus hears in the womb long before the formation of the auditory system and from the 7th week of pregnancy, the vibrations of the music or the various sounds perceived give the child his first real emotions. Music promotes logical development and memorization.

Also, the sensory modalities of taste and olfaction are functional very early, practically from the fourth month of intrauterine life. The fetus perceives primary flefors, its mother's scent contained in the amniotic fluid and memorize them. It's also known that it reacts emotionally to the touch of any area of the mother's skin, but also through the emotional state of the mother herself.

Scientists have only recently shed light on the mystery of infantile consciousness. They determined a trend toward an awakening that already occurs during the last month of pregnancy. Although we do not yet have scientific evidence for the effects of intellectual stimulation in the prenatal period, but we have enough observations that stimulation before birth has the effect of faster intellectual development of the child.

Directly by sounds or by touching mother's skin, working on the mother's memory through certain intellectual activities, but more complicated or difficult, that require additional mental effort. Nevertheless, the father's participation is as well as important.

6. Recommendations

It would be advised to follow such observations on a large number of pregnant women from a statistical point of view. It would also be interesting to involve in the study the influence of the father and special events that occur around the pregnancy. Intellectual stimulation at the earliest stages of life should be one of the most important concerns of health professionals in maternity and neonatology. It should be introduced in included in maternal care programs. It should also be a fundamental problem of states and international organizations in the field of human health and well-being, in the so-called well-being of MAN, as well as in education (WHO, UNICEF, UNESCO).

7. References

1. Ostrowski ZL. Stimulation intellectuelle au tout début de la vie. Harmattan. 2018.
2. Morgan B. Morgan R. Brain food. Michel Joseph Ltd, London. 1986, 136.
3. Tanner JM. Foetus into man. Physical growth from conception to maturity. Fletcher & Son, Norwich. 1978.
4. Jacobson M. Developmental neurobiology. Plenum Press, New York. 1978, 221.
5. Blackburn ST, Maternal, fetal, and neonatal physiology. E-book: A Clinical Perspective, 5th ed. Elsevier Health Sciences. 2017, 564-583.
6. Anderson AL. Thomason ME. Functional plasticity before the cradle: a review of neural functional imaging in the human fetus. NeurosciBiobehav Rev. 2013, 37, 2220-2232.
7. Clopath C. Vasilaki E. Buesing L. et al., connectivity reflects coding: a model of voltage-based spike-timing-dependent-plasticity with homoeostasis. Nat Neurosci. 2010, 13, 344-352.
8. Curzi-Dascalova L. INSERM. Hôpital Antoine BeclèreClamard. In: Ostrowski Z.L. Stimulation intellectuelle au tout début de la vie. Harmattan. 2018, 24.
9. Roffwarg H. Muzio JN. Dement WC. Ontogenetic development of human sleep dream, cycle. Science. 1966, 152, 604-619.
10. Dunkel Schetter C. Psychological science on pregnancy: stress processes, biopsychosocial models, and emerging research issues. Annu Rev Psychol. 2011, 62:531–558. [PubMed] [Google Scholar]
11. Bayne T Frohlich J. Cusacki R. Moser J. Naci L. Consciousness in the Cradle: On the Emergence of Childhood Experience: Trends. Cognitive Science. https://doi.org/10.1016/j.ties.2023.08.018
12. Querleu D. Clinique obstétrique Roubaix. In : Ostrowski, ZL. Stimulation intellectuelle au tout début de la vie. Harmattan. 2018, 59-60.
13. Partanen E. Kujala T. Tervaniemi M. et al. Prenatal music exposure induces long-term neural effects. PLoS Digital Health. 2013, 8, 6.
14. Rauscher H. Shaw GL. Ky CN. Music and spatial task performance. Nature. 1993, 365, 611.
15. Ostrowski ZL. Intellectual stimulation at the very beginning of life, Pediatr Pol. 2022, 97(3), 254-259.
16. Gonzales-Gonzles NL Suarez MN. Perez-Pinero B. et al. Persistence of fetal memory into neonatal life. Acta Obste Gynecol. 2006, 85, 1160-1164.

17. Veldman F. Haptonomie; Science de l'affectivité. Presses Universitaires de France, hors collection. 2007.

18. Bremner AJ. Spence C. The Development of Tactile Perception. Advances in Child Development and Behaviour. 2017, 52, 227-268.

19. Field T. Touch in Early Development. Erlbaum, New Jersey. 1995.

20. Schanberg SM. Kuhn CM. The biochemical effects of tactile deprivation in neonatal rats. Prospect Behave Med. 1985,2, 133-148.

21. Cupa D. Une topologie de la sensualité: le Moi-peau. Revue française de psychosomatique. 2006, 1(29), 83-100.

22. Anzieu D. Le Moi-Peau. WordPress.com. 1974.

23. Anzieu D. Le Moi-Peau. Dunod. 1985, 140.

24. A study carried out with Psychology Spot and published in Good Housekeeping. https://www.passeportsante.net/fr/Actualites/Nouvelles/Fiche.aspx?doc=intelligence-bebe-enfant-mere-gene-chromosomes

25. https://www.cosmopolitan.fr/,c-est-prouve-l-intelligence-est-transmise-par-la-mere,1970213.asp

26. Lehrke RG. Sex Linkage of Intelligence - The XFactor. Ed. Praeger. 1997.

27. https://www.techniques-ingenieur.fr/actualite/articles/notre-intelligence-est-elle-determinee-par-nos-genes-31316/

28. https://www.sci.news/genetics/intelligence-gene-networks-03530.html

29. Gardner H. Frames of Mind: The Theory of Multiple Intelligences. 2011.