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ORIGINAL ARTICLE

Fetal psychism: neurodynamic and psychoanalytic bases

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Abstract

Backgroung: Neuroscientific research has provided great discoveries regarding the understanding of the brain functioning and its neural circuits. With advances in studies on fetal behavior, new discussions have arisen about the existence of a possible rudimentary psychic apparatus. Questioning the existence of a psychism in the fetus becomes doubly challenging. First, because of the controversy that exists in the field of neuroscience about the studies of epiphenomena. Second, because of the difficulty that psychoanalysis has in accepting the existence of a psychic structure before birth. This study was carried out considering all these controversies and scientific limitations, and for this reason it should be understood as a theoretical hypothesis and an invitation to a broad and transdisciplinary view on the complexity of human behavior. From an extensive review on the development of the nervous system and fetal synaptogenesis, and combining neurophysiological and neurophysical research, it was possible to create a link with the Freudian theory of psychic energy described in the Project for a scientific psychology. From these joints, questions were raised about fetal development, especially in the preterm phase, which would be composed of intense synaptic activities, especially in the somatosensory and thalamocortical regions that would receive exogenous and endogenous stimuli, both acting to generate an accumulation of psychic energy. Thus, it was hypothesized that this intense flow of energy would be the first sign of the development of the primitive psychic apparatus in the fetus. Thus, it was possible to assume that during the preterm period this cathected energy discharge could project directly onto the limbic and motor brain structures and leave unconscious memory traces of intrauterine life experiences. These influences of a psychic nature, together with epigenetic factors, would contribute to the appearance of certain behavioral and neurodevelopmental disorders. Therefore, suggesting an early transdisciplinary approach in at-risk infants exposed to environmental or epigenetic stressors during the gestational period, especially during the synaptic plasticity window, will provide a therapeutic opportunity through psychic reorganization and sensorimotor integration.

Keywords: fetal psyche, synaptogenesis, neurophysics, psychoanalysis, behavioral neuroscience, fetal development

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Authors summary

Why was this study done?
To describe a possible fetal psychism and unveil the behavioral and psychic mechanisms involved in fetal maturation and possible neurodevelopmental disorders, as well as triggering means for an early intervention in the field of neuropsychiatry and psychoanalysis.

What did the researchers do and find?
An empirical literature search was carried out with terms from the field of neuropsychiatry and psychoanalysis, such as synaptogenesis and fetal neurodevelopment, as well as on the electrical activities of the brain in premature newborns. Based on these assumptions, a line of thought and development of the hypothesis was described that during the fetal period there are intense synaptic activities, especially in the somatosensory and thalamocortical regions that receive exogenous and endogenous stimuli, both acting to generate an accumulation of psychic energy. This intense flow of energy can be considered as the first sign of the development of a primitive fetal psyche. During the fetal period this cathected energy discharge (cathexis is the process by which libidinal energy available in the psyche is linked to or invested in the mental representation of a person, idea or thing) by projecting itself onto the physical cerebral apparatus induces motor reflex responses focused on the act of fetal maturation and preparation for delivery.

What do these findings mean?
The significance of the potential understanding of the functioning of the human psychic system since intrauterine life and the discussion of how this psyche can act on the physical cerebral apparatus during fetal development, as well as promoting (or not) disturbances within the neural circuits. These influences of a psychic nature together with epigenetic factors can contribute to the appearance of behavioral and developmental disorders. In another complementary line, addressing early transdisciplinary issues in infants at risk, especially during the synaptic plasticity window (in early childhood) seems to provide a therapeutic opportunity through psychic reorganization and sensorimotor integration, providing greater protection and structural organization of neural networks of behavior.

INTRODUCTION

Talking about fetal psychism leads to a controversial and challenging discussion that imposes a transdisciplinary dialogue. Researchers have been dedicated to studying and analyzing fetal behavior for many years. Thinking about fetal psyche is not something recent. In 1945, Arnold Gesell wrote in his book The Embryology of Human Behavior: The Beginning of the Human Mind[1] that “as the body took shape, the psyche would also take shape”, something that remains controversial to this day.

It is essential to emphasize that the study of fetal psyche implies discussing a possible structuring of a rudimentary psychic apparatus, but which will only be organized after birth. That is, the objective of this study is focused on theoretical questioning with a scientific basis for understanding the development of the Central Nervous System (CNS) considering the preterm period (after the 25th week), a phase in which a great neuronal migration and great cortical synaptogenesis begins.

If, nowadays, neuroscientific studies cannot confirm the existence of neuronal activities in the face of exogenous stimuli during the gestational period, studies with fetal ultrasonography, on the other hand, can identify reactions and behavioral patterns that lead us to consider that there are somatosensory reactions in fetal life[2-5]. Intra- and extra-uterine environmental factors seem to provoke some kind of stimulus that leads to brain neurophysiological activity. Could this electrical activity in the brain be the same “Q energy” described by Freud in the Project for a Scientific Psychology[6], the basis of the structure of the human psychic apparatus?

Given this hypothesis, it is possible to think that the psychic apparatus would be initiating a structuring process during the development of the fetal period. Based on these considerations, in this work a construct of ideas will be developed without ever wanting to create a unifying reductionist model that can explain the psychic apparatus or the fetal psyche, since these questions require a view of complexity and reject a simplifying view.

Through the articulation of neuroscientific, physical and psychoanalytical knowledge, the objective will be the theoretical defense of the existence of a fetal psychism, since the Central Nervous System (CNS) is in structural/synaptogenic plastic development, generating a flow of electrical activities. Consequently, receiving and producing energy, or why not say it, the free energy described by Freud in his Project for a scientific psychology[6-8]. This constant flow of free energy is formed from exogenous sources, coming from the external environment (intra or extrauterine) and endogenous, coming from the essential biological needs for a homeostatic balance aimed at fetal self-preservation (such as: maternal nutrients via the umbilical cord).

Considering the Freudian theory of “Q energy”, it can be assumed that, when penetrating neurons from exogenous sources, it can initially flow without contact barriers, but with constant oscillations that accompany the development of the fetus from, mainly, from the last gestational trimester. When the fetus reaches the preterm period, its disproportionate growth to the uterine cavity space, the reduced demand for basic nutrients for its survival, and the very genetic factor of maturation and development of the cerebral cortex, would increase psychic tension and provide the beginning of the formation of the contact barrier, working to reduce the excess of energy flow into this mental apparatus, which is still being structured.

It would be this excess of “Q energy”, together with the formation of a contact barrier, which would lead to neuronal cathexis and the increase in Qn (intercellular) energy causing a kind of “emotional awakening” for the act of being born during the birth period. Thus, the low cathexis flux could also promote an inverse behavior.

It is assumed that this psychic apparatus, still in formation, will continue to structure and unfold in postnatal life, always in constant oscillatory fluxes. Development will tend to provide a sufficiently organized neuropsychic balance. It will be this balance that will provide a cognitive, affective and motivational behavior adequate to the socio-affective and environmental contingencies that will be imposed throughout life. Furthermore, it should be considered that epigenetic, social, environmental and cultural factors may also influence the organization of the mental apparatus and neuropsychic balance.

Initially, we chose to describe studies on the development of the fetal CNS and its neurochemical, synaptic and neurophysiological functions. To then raise some considerations about fetal psychism through the study of the Project for a scientific psychology written by Freud in 1895. In this way, it is proposed to contribute to an approximation between psychoanalysis and other sciences, considering the complexity that involves understanding of human behavior.

The development of the CNS

One of the main functions in the development of the CNS is, without a doubt, the creation of neural networks and brain plasticity. The communication between different cortico-cortical and cortico-subcortical areas, in addition to the immense capacity to reorganize and have plasticity, especially in the fetal period and in the first years of life, makes the human brain a great source of energy, at the same time which turns out to be extremely vulnerable.

In general, around the 5th week of the postconceptional week (pcw) the neural tube closes and from the 6th week, still in the ventricular germinal layer, the first neuronal cells are generated and quickly migrate from the ventricular zone to a region more superficially cortical, radially or tangentially, to form the subcortical plate[9-11]. Still following this process of neuronal differentiation and migration, another group of neurons formed by Cajal-Retzius cells, also radially, will reach the most marginal zone, which will be the future excitatory cortical neurons, while the inhibitory neurons migrate tangentially[12-14].

It is known that the subcortical plate is extremely active around the 28th week, generating great synaptogenic activity, that is, the earliest process of synaptic plasticity starts during the late fetal period and predominates in the frontal and parietal regions[11] . This region very early sends and receives projections from different circuits, including the thalamocortical ones. In other words, around the 20th week the basal forebrain and thalamus projections will be the main projections for the subcortical plate, as well as the callous and association fibers[9,11,15].

In the last gestational trimester, the subcortical plate begins to undergo a self-programmed death or apoptosis, thus causing an important reduction in its thickness. However, half of the neurons in this plate will transform into GABAergic interstitial neurons of the subcortical white matter and the future bundles that will be fundamental for the formation of neural networks and brain connectivity[9, 11, 12, 16-18].

It is noteworthy that all this neuronal differentiation follows a neurochemical basis. This neurochemical molecular action becomes fundamental in synaptic plasticity, synaptogenesis, migration and formation of cortical plates and brain connections.

It is known that norepinephrine starts to regulate the development of Cajal cells around the 6th week, which are the first neurons of cortical origin[19]. Glutamatergic neurons begin to produce synaptic activity in pyramidal cells around week 9[19]. The dopaminergic neurons that will be critical in motor, motivational and reward behavior begin their migration and their role in migration and synaptogenesis around the 6-8th week[19]. The role of serotonergic neurons in the migration, synaptogenesis and differentiation of progenitor cells begins around the 12th week[19].

Finally, it is worth emphasizing the importance of GABAergic neurons that even in the fetal period have an excitatory action influencing the processes of maturation, proliferation, migration, synaptic maturation and cell death, and only in the postnatal period will they acquire their inhibitory function[18- 21].

Synaptic plasticity in the fetal period

When talking about synaptic plasticity, one immediately thinks that brain plastic function depends on stimuli and experiences. The first studies that proved the presence of experience-dependent synaptic plasticity were carried out by Hubel and Wiesel[22-24]. The authors found that newborn kittens, when exposed to monocular visual deprivation from the dominant eye, transferred visual dominance to the non-dominant eye, which was not deprived. From this study, the term "experience-dependent synaptic plasticity" emerged, being of fundamental importance in the development of neural circuits[22, 24-26].

The study described above served as the basis for thinking about the synaptic plasticity process and its role in the development of the human brain. However, the most challenging question was to investigate at what point in embryonic and fetal development the function of synaptic plasticity would begin and whether this would already be dependent on experiences still in intrauterine life. What is known is that there is a synaptogenesis process during the earliest period of fetal life, right after the closing of the neural tube, and a peak of expression of genes that act on the synapses function, occurring soon after this period.

During the late gestational period, synapses are already observed in the subcortical plate and in the marginal zone, while after the 25th week synapses begin to develop rapidly in the cortical plate that starts to form[27-29]. Thus, it can be stated that the subcortical plate is where the most early functional activity and neural connectivity in humans occurs, which occurs around the 25-28th week[11, 30, 31].

Moore *et al.,* studied in vitro whether subcortical plate synaptic potentials could be evoked during the late gestational period. Although the authors proved the existence of synaptic activity, studies showed that the fetal circuit was spontaneous and endogenous, and that during the temporal window it was difficult to say that the influence of environmental factors would affect synaptic development. On the other hand, the studies by Moore *et al.,*[30,31], as well as the studies by Allendoerfer and Shatz and Friauf and Shatz, showed that subcortical plate neurons could be activated by stimulating thalamic axons before cortical plate neurons[32,33], leading to the assumption of experience-dependent synaptic activity in the preterm period.

Later, studies carried out in human fetal brains observed that the first synapses detected in the cortical plate of the somatosensory and visual cortex were seen only after the 23rd week, a period described by Kostovic and Judas as "sensory-expectant". On the other hand, after the 24th week to term, there was a significant change in the cortical response, as responses evoked by peripheral stimulation were observed[11,34,35]. Of genes involved in synaptogenesis, especially of the cortical plaque.

Perhaps one of the most important contributions in studies on synaptic plasticity is due to its importance in the development and maturation of neural networks and, consequently, of brain connectivity. Very early dysfunctions in this synaptic function can lead to future dysfunctions in connectivity, which can predispose to the onset of disorders such as autism, among others.

When talking about synaptic functions, one must think about the issue of excitation-inhibition balance, which is the basis of brain neurophysiological functions and the balance of neurological functions. Thus, the hyperexcitability of certain circuits can cause different behavioral disorders. Thus, considering the issue of excitation-inhibition balance, it is worth emphasizing the importance of the action of GABAergic and Glutamatergic neurons and their action on synaptic terminals and on the excitation/inhibition rate (E/I ratio) fundamental for future cognitive and behavioral functions[36].

When thinking about the Glutamatergic/ GABAergic excitation-inhibition balance, the role of the microglia must also be emphasized, since it has a great importance in synaptic pruning[35-39]. In intrauterine life, still in the embryonic stage, exposure to immune responses may occur due to external immune stressors such as toxins, infections, or maternal immune aggression. Like Maternal Immune Activation (MIA), these immune responses are directly related to microglial activation[37-39,41-44].

More recently, studies on the role of microglia in brain growth through the regulation of neurogenesis and synaptogenesis by the synaptic pruning mechanism have increased[37, 39, 45]. Studies in rats show that even in the yolk sac, erythromyeloid progenitor cells will produce cells called pre-macrophages that will be sent to the brain and will be considered microglial progenitor cells. These cells tend to expand and maintain themselves throughout life to eventually form the resident population of the adult brain[44,46,47].

Several studies show that the role of microglia in synaptic pruning appears to occur in an experience-dependent manner[39,44]. Considering the aforementioned studies, where it is evident that fetal synaptic action seems to be regulated by microglial pruning, it is possible to assume that in the preterm fetal period, there is already an experience-dependent synaptic function.

When considering that there is a synaptic function, we are attributing that both in the subcortical plate and in the fetal cortical plate, there is already a capacity to transmit somatosensory information, which translates into the production of electrical brain activity and, consequently, of psychic energy flow. For this reason, it is essential to understand more about CNS electrophysiology in the fetal development period. These studies were carried out based on the discovery of electroencephalography made in 1929, by Hans Berger, and later on by the studies on premature babies carried out by Dreyfus-Brisac *et al.*,[48-53].

Recording of electrical brain activity as a tool for analyzing the development of the Central Nervous System

Every development of brain electrical activity shows a progressive maturation that begins in the second half of intrauterine life[48]. One of the main neurophysiological findings observed in premature infants refers to the so-called Transient Spontaneous Activities (AETs). Around the 24th-26th of postconceptional week (pcw), which appear more evidently in the regions of the visual, auditory and somatosensory cortex. This period also coincides with a progressive increase in thalamocortical projections. As the cerebral cortex matures, transient activities become more diffuse, more prolonged and with low amplitudes.

Thus, there is a predominance of theta waves and occipital delta waves that are visible around the 30th week. The alpha rhythm starts to appear around the 20th week in the rolandic and occipital regions, and around the 28th week they mix with delta activities (delta brush). Upon reaching the end, these activities are observed in an organized manner and in frontal and parieto-occipital modules that project themselves synchronously and bilaterally[48,53,54].

When considering that in the preterm fetal period, there are already electrophysiological patterns that demonstrate the presence of electrical brain activities, this means that the process of synaptogenesis, synaptic transmission (through its excitatory and inhibitory pre- and postsynaptic potentials) and connectivity brain already started. This leads to considering that in the last gestational trimester the production of electrical activity would be producing a flow of energy.

For the hypothesis that there is a fetal psyche through the Freudian theory of Q energy[55], the existence of energy production and electromagnetic fields was considered as products of the intense activity of information transmission between neurons and between different brain regions. This energy or electrical brain activity that can be measured and recorded using electroencephalography or magnetoelectroencephalography cannot be treated as the source of psychic energy, but can be used as proof that the brain produces electrical activity which has been present since fetal life.

However, when it comes to talking about psychic energy, the source of this energy cannot yet be quantified or analyzed, however, if we look at some theoretical knowledge of physics (something that Freud already mentioned in the Project for a scientific psychology, even if in a way subtle "First of all, there is no doubt that the external world constitutes the source of all the great amounts of energy, for, according to the discoveries of physics, it consists of powerful masses that are in violent movement and that this movement is transmitted by the so-called masses" p. 356). In this sense, it becomes fundamental and challenging to understand the role of quantum-mechanical physics for the mind-brain problem.

So far quantum physics has made great contributions to the understanding of the mind-brain problem with regard to the question of consciousness. Neuroscientific advances have taken the understanding of neural circuits to a molecular dimension of nanoscales.

It is known that from a microscopic point of view the neuron has a body, an axon and apical and basal dendrites whose function is to receive and transmit electrical impulses. This electrical transmission occurs through the constant opening or closing of voltage-dependent ion channels, both inhibitory and excitatory, which are present in the neuronal membrane, inducing a propagation of electrical current along the axon until reaching the synaptic terminals[56].

For Beck and Eccles, 1992, neocortical microstructures could produce nervous impulses that would lead to the emission of transmitter molecules through the exocytosis process (cellular process of release of intracellular substances to the extracellular environment). Considering that exocytosis is a quantum phenomenon of the presynaptic vesicular grid, the authors proposed a theory with the idea that every conscious voluntary act would become effective by increasing the probability of releasing vesicles from thousands of synapses of each pyramidal cell that would occur by quantum selection[57].

Eccles, through his great experience as a neurophysiologist and Nobel laureate in medicine, proposed that there would be structures composed of very fine fibers and their connections, which would be what he called dendrons. And on the mental side there would be psychons that would operate in synapses through quantum processes

For quantum physics the behavior of elementary particles must be considered with indeterministic characteristics since one cannot predict with certainty the future state of another individual particle, but can only calculate its probability[57]. Thus, according to the laws of quantum physics, the epiphenomenon should not be discarded as a scientific study.

In this way, John Eccles' studies took an in-depth look at quantum mechanics and the effects of the mind on the physical apparatus of the brain[58–65]. Thus, seeking to study the mind-brain problem, Eccles proposed that mental events could cause brain events similarly to the wave function $\Psi(x,t)$ which in quantum mechanics determines the probability $|\Psi(x,t)|$ 2 of a given quantum particle be found at an x position at a certain moment in time *t*.

Knowing that quantum mechanics would govern the behavior of physical systems at the nanoscale level, Eccles hypothesized that quantum effects could manifest in the processes of neurotransmitter release by synaptic vesicles. It is now known that synaptic vesicles are about 40nm in diameter and would be subject to the quantum uncertainty relationship.

For Beck and Eccles, this action of releasing neurotransmitters in synaptic vesicles would be subject to an uncertainty relationship due to the probability of exocytosis being much lower than 1 after each depolarization, due to the quantum tunneling effect (this is a phenomenon proven by mechanics quantum, in which particles can transpose an energy state that by the laws of classical physics would not be possible).

Thus, quantum physics assumes that a particle can cross regions surrounded by potential barriers even if its kinetic energy is less than the potential energy of the barrier, and once it crosses this barrier the energy of the particle remains the same and what changes is the amplitude of the quantum wave[57, 66].

Thus, for Beck and Eccles the model of neuronal exocytosis could be explained considering that each axon terminal would contain approximately 50 synaptic vesicles anchored in a grid of presynaptic vesicles. If an electrical potential were applied and depolarized the terminal axon, more than one synaptic vesicle would release neurotransmitters into the synaptic cleft and the probability for this event to occur would be 0.4.

Beck and Eccles, 1992, considered that because each axon has more than 1000 presynaptic terminals, if neurotransmitter release were due to the classic model of random thermal fluctuations, then the brain's functional mechanism would be released within a few seconds within a complete chaos[57,60]. For this reason, he considered that the organizational structure of the brain was not compatible with this type of disorganization, and that for this reason the probability of neurochemical release in the presynaptic cleft should be of mechanical origin and subject to direct causal influence by means of your own conscience. Thus, for Beck and Eccles, the mind composed of conscious experiences could causally interact with the brain without violating the laws of quantum physics[57].

Despite the study by Beck and Eccles, 1992, considering the conscious voluntary act, something that would not be possible to occur in the fetus, we can consider that biophysical studies have not yet advanced the question of the idea proposed by Freud under a possible flow of unconscious energy.

In other words, it might be supposed that retained memories that express past experiences, many of which are pleasant or unpleasant, traumatic or not, could behave like a kind of unconscious experience that could also causally interact with the brain. Thus, we should think that the complexity of the human mental apparatus leads us to probabilities and denies determinism. In this way, thinking about the conscious mind and the Freudian dynamic unconscious becomes every day more plausible and scientifically possible.

Considering Beck and Eccles' assumption, conscious experiences would not be possible to happen in a fetal brain. However, with the fetal brain in its phase of intense cortical synaptogenesis, something that occurs around the 28th week, this period could also be considered as having a high probability for the existence of a quantum effect on the terminals of pyramidal cells that would already be present in the cerebral cortex.

For quantum physics, processes related to brain functions would directly depend on the functions of ion, molecular, and atomic channels, which are considered to have a quantum effect[67]. This flow of synaptic transmission and axonal depolarization with release of neurotransmitters in presynaptic vesicles would be happening intensely and generating quantum waves that in the preterm period would already be related to exogenous somatosensory experiences and endogenous pathways.

Wouldn't this flow of energy from the pyramidal neurons of the cerebral cortex, already present in the brain before birth, be responsible for the production of an energy that would organize and structure the human psyche even in fetal life?

Thus, returning to the studies by Beck and John Eccles, 1992, what was observed referred to exactly the presence of a quantum locus in the presynaptic reticulum of pyramidal cells. Now, if glutamatergic neurons start to produce synaptic activity in pyramidal cells around the 9th week, and as these excitatory glutamatergic neurotransmitters are one of the first to migrate to the subcortical plate and later to the cortical plate, there is a probability that a wave of energy can produce quantum effects and psychic energy without directly occurring the process of consciousness.

Considering this idea, and given the fact that the fetus is neurophysiologically in a sleep state, how would it be possible to explain the psychic and neurophysiological mechanisms of fetal psychic energy?

The "dream" fetus

One of the most important electrophysiological characteristics in the study of preterm electroencephalography concerns transient spontaneous activities. These activities can be considered one of the characteristics of immature brain structures[68].

Vanhatalo *et al.,* 2005 carried out an experiment with EEG recordings in sleeping premature babies and observed that much of the preterm EEG activity was confined to slow and spontaneous transient activities, which were characterized by oscillatory activities in different frequency bands between 0.1-30 Hz. Deflections of about 800 microV were observed in the temporo-occipital regions, with a rate of 8 minutes, and their occurrence and amplitude tended to decline when reaching the maturity period corresponding to birth. For the author, the slow endogenous transient activities of the immature human neocortex would be related to the prenatal period and would end in parallel with the maturation of functional GABAergic inhibition[68].

Dreyfus-Brisac and Monod, 1965 performed a polysomnography study in preterm and full-term babies[48]. In an adult what is normally observed is a sleep cycle composed of quieter slow waves (NREM), followed by rapid cycles of active sleep, rapid eye movements, poor muscle activity and increased breathing pattern, which correspond to 20 % of total sleep[49,69,70].

In term neonates, a characteristic pattern with two phases (REM and NREM) is observed[47]. However, Dreyfus and Monod observed that in preterm babies there was no differentiation between the EEG during sleep and wakefulness and, therefore, they were interested in finding clues that would correlate these findings with the absence or presence of other vegetative and somatic differentiation parameters between wakefulness and sleep. Then for one year the authors recorded 26 polygraphic studies of preterm infants taking them for periods of two to three hours, between two feeds, or for periods of five to six hours, including a feeding[48,71].

The results of the study revealed that the sleep cycle was initially absent in premature babies and that chin movements appeared occasionally. When the premature baby reached the equivalent of full-term age, it did not have the same sleep cycle as the full-term newborn. The regularity and duration of each period of silence and active sleep was not the same; in the interrelationship between EEG, motility and respiratory and cardiac function, the rhythms were not as well defined as in full-term newborns.

Chin movements often persisted when the premature child reached full-term age, unlike neonates where they were seen only for short periods of time and with low amplitude. As for the percentage of irregular breathing periods, eye and chin movements were very variable.

Dreyfus-Brisac and Monod, 1965 also noted the absence of a complete sleep cycle before the 37th week of pcw[48,71]. Thus, these findings, associated with EEG studies in premature infants, reveal that there is a pattern of oscillation in brain frequencies during sleep, which, despite not existing as a complete cycle in premature infants, demonstrate electrophysiological patterns that support the hypothesis that the fetus is physiologically asleep.

Now, it has been known for decades that the fetus in utero spends most of its time in a state similar to REM sleep (Rapid-Eye-Movement), a period in which most vivid dreams occur in adults. There also seems to be little doubt that this sleep state is a key factor in the development of the central nervous system[72]. The most challenging issue, however, and which involves the issue of the epiphenomenon of the dream, would be the assumption that when this fetus is sleeping in its preterm phase, it would be dreaming. But what would the content be?

One of the first hypotheses about the function of sleep was made by Hobson et McCarly's[73] and was based on the premise that dreams are the result of random activities originating from the brainstem, specifically the pons, producing so-called PGO waves during REM sleep. , where P comes from a bridge (where the waves are generated), the geniculate nucleus of the thalamus (G) through which sensory information passes and, finally, the occipital areas (O) where visual information is processed.

For Hobson et McCarly's these random activities would pass through sensory relay stations bringing information from the environment and being interpreted in a way that would lead to the dream phenomenon[73]. Thus, for the authors, dreams represent conscious experiences of oneiric states and are streams of electrical waves oscillating randomly without specific organization or pattern.

In addition, the neuroscientific studies carried out by Revonsuo defend that the role of the dream would be of an adaptive and evolutionary character[74]. So Revonsuo contradicts the random by-product theory of REM sleep physiology. For the author, the dream content would not be random or disorganized, but it would be organized and selective where the brain would build a complex model of the world in which dream elements when compared to the elements of vigil life would be under-represented or over-represented and would be modulated by certain types of life experiences. Thus, the main neurobiological function of dreams would be the simulation of events and tests for the perception of threatening stimuli.

Based on this hypothesis, Revonsuo stated that in our ancestors the environment and experiences would be extremely threatening and brief. Any behavioral advantage to face dangerous events would increase the chances of reproductive success. Therefore, dreams tend to select threatening waking events and continuously simulate them with different combinations to maintain skills and reinforce the capacity to deal with threats[74].

Revonsuo's studies[74] were influenced by another robust study carried out in 1966 by Hall and Van de Castle which, when analyzing 500 dream reports, found that 80% contained negative emotions, while only 20% contained positive emotion[75]. These dreams had threatening content pointing to an over-representation of these events, which should not happen if the dream content was random.

Despite all the efforts of neuroscientific studies, we are still facing many gaps and questions about dreams. For example, if dreams have as their content the visual experiences of waking life, what do individuals who have congenital blindness dream about?[76].

Analyzes of dream records collected from individuals show that different sensory experiences can be experienced and remembered. Although visual experiences are present in the vast majority of reports, tactile and sound sensations correspond to 40-60% and 15-30% of dreams, respectively. The studies carried out by Meaidi *et al.* 2014[76] revealed that individuals with congenital blindness had less dream impressions related to visual content, and more auditory, tactile, olfactory and taste content when compared to the group that presented late blindness.

The importance of reporting these neuroscientific studies aims to question and broaden the view, especially with regard to intrauterine life and fetal psyche. For this reason, it is essential to add to these studies the Freudian theory of psychic constitution described in the Project for a scientific psychology.

CONCLUSION

In short, we can consider some issues that somehow seem prohibitive to be discussed in the scope of science, but which greatly expands our view of human behavior.

First, we must theorize that the energy flow produced by the experiences of the fetus in contact with the environment, that is, exogenous energy, and by the endogenous demands of fetal physiological needs, work through synaptic connections and the release of neurotransmitters producing an energy flow psychic.

It is noteworthy that in Freud's theory, in fetal life there would be no psychic apparatus. However, it is possible to rethink the Freudian theory using current neuroscientific studies which demonstrate that in the preterm phase this fetus already presents an intense synaptogenesis and migration of neurons to the cortical plate. This flow of sensory stimuli in the form of energy, at first, will be discharged with less intensity in the first months of life, aiming to maintain a neuropsychic balance during fetal development. Thereafter, it will suffer "disturbances" by the increased flow of energy that begins to intensify as the fetus reaches its birth period[6].

Furthermore, considering that this fetus is in a sleep state, sensory elements can feed the forebrain circuit activating responses with primitive dream impressions with sound and tactile contents[2,77].

As the fetus reaches its term period, these stimuli become more intense, causing an increase in psychic tension due to a greater maturation of the somatosensory cortex and a greater uptake of external stimuli, as well as a greater sense of bodily discomfort by reducing the space related to increased fetal size compared to the uterine cavity. Finally, a homeostatic imbalance can occur due to the need for more nutrients to maintain basic fetal survival needs.

This fetus, which was in a "dream state", at first would have a free energy flow passing without contact barriers*, but without a great intensity of energy that would provoke reflex activations of the motor and limbic system. However, progressively this flow of energy would tend to intensify.

**Described by Freud in the Project for a Scientific Psychology page 350-354. Contact barriers occur in the passage of energy from Phi Φ neurons to Psy Ψ. Phi neurons Φ would be those permeable and that would be in contact with sensory organs receiving energy from the external world (exogenous energy). The Psy Ψ neurons would be the neurons that would suffer a cathexis and would be carriers of a memory and when receiving the energy that crossed the contact barrier, never returning to its previous state.*

For Freud, the amount of energy coming from the outer periphery would represent the source of all large amounts of energy. Therefore, the problem of fetal psychic energy would not be a problem of quality, as this would involve consciousness, but a problem of quantity.

In this sense, it can be asked, considering Freud's theory, if there would not be a kind of cell contact barrier that would attenuate the entry of energy flow to the Phi (Φ) neurons, which tend to discharge their energies directly onto the device. motor. And as this energy increases in quantity, more energy passes and more psychic tension builds up. But what would be the reason for exogenous and endogenous stimuli to accumulate and suddenly disturb the neuropsychic balance that was present during the entire gestational period?

In this sense, it is necessary to raise a hypothesis that, despite being controversial, requires a broad discussion. We will use what Freud calls the Problem of pain. It is important to emphasize that the pain mentioned here is not a physical pain, but a feeling of displeasure that can only occur in the preterm phase when there is greater maturation of the cortical plate.

For Freud, all devices of biological nature would have efficiency limits and would fail when a limit was exceeded. Considering that the large amounts of external energies (Qs) do not completely penetrate the barriers that protect the Phi (Φ) neurons, only a type of device such as pain could break this barrier and cause an excess energy flow input causing Phi (Φ) neurons discharge this cathected energy directly to the physical cerebral apparatus and to structures that regulate limbic and motor responses.

For Freud, the precipitating causes of pain would be, on the one hand, “the increase in quantity: all sensory excitement, even those of the superior organs of the senses, tends to transform into pain whenever the intensity increases”. Perhaps this increase in the amount and intensity of exogenous and endogenous sensory stimuli worked to create a contact barrier between Phi (Φ) and Psy (Ψ) neurons and as some energy managed to pass through this barrier, Phy (Ψ) neurons would remain cathected and some kind of mnemonic trace would be retained in an unconscious still being structured.

Freud stated that pain would go through all discharge pathways “Pain undoubtedly leaves permanent facilitations behind it, in Psy (Ψ) – as if struck by lightning – facilitations that possibly completely break down the resistance of the barriers of contact and there they establish a way of communication like those that exist in Phi (Φ)”.

The hypothesis raised in this work is that as the fetus reaches its maximum point of neurobiological maturation, the intensity of the amount of energy Qs increases, which leads to a feeling of displeasure and accumulation of psychic tension that needs to be discharged on the limbic and motor system. This excess of sensory stimuli and sensations causes a “psychic pain”, or a feeling of displeasure, which will move this fetus to more energy discharges on the physical cerebral apparatus to the point of triggering a rupture movement with the uterus and a search for self rid of displeasure through the act of being born.

Finally, it is necessary to expand the discussions on the importance of the functioning of the human psychic apparatus since intrauterine life. Discuss how this psychism can act on the physical brain apparatus during fetal development and promote, or not, disturbances within the neural circuits. These influences of a psychic nature, together with epigenetic factors, can contribute to the appearance of behavioral and neurodevelopmental disorders by leaving unconscious memory traces of intrauterine life experiences. Thus, demonstrating the importance of an early transdisciplinary approach in infants at risk, especially during the synaptic plasticity window, will provide a therapeutic opportunity through psychic reorganization and sensorimotor integration, providing greater protection and structural organization of neural networks of behavior.

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Resumo

Introdução: As pesquisas neurocientíficas têm proporcionado grandes descobertas no que concerne ao entendimento sobre o funcionamento cerebral e seus circuitos neurais. Com os avanços nos estudos sobre o comportamento fetal novas discussões têm surgido acerca da existência de um possível aparelho psíquico rudimentar. Questionar a existência de um psiquismo no feto, torna-se duplamente desafiador. Primeiro pela controvérsia que existe no âmbito da neurociência sobre os estudos dos epifenômenos. Segundo, pela própria dificuldade que a psicanálise tem em aceitar a existência de uma estrutura psíquica antes do nascimento. Este estudo foi realizado considerando todas estas controvérsias e limitações científicas, e por este motivo deve ser entendido como uma hipótese teórica e um convite para uma ampla e transdisciplinar visão sobre a complexidade do comportamento humano. A partir de uma extensa revisão sobre o desenvolvimento do sistema nervoso e da sinaptogênese fetal, e associando as pesquisas neurofisiológicas e da neurofísica, foi possível criar uma articulação com a teoria Freudiana da energia psíquica descrita no Projeto para uma psicologia científica. A partir destas articulações, levantou-se questionamentos sobre o desenvolvimento fetal, especialmente na fase pré-termo, o qual seria composto por atividades sinápticas intensas, especialmente nas regiões somatossensoriais e talamocorticais que receberiam estímulos exógenos e endógenos, ambos atuando para gerar um acúmulo de energia psíquica. Desta forma, criou-se uma hipótese de que este intenso fluxo de energia seria o primeiro sinal do desenvolvimento do aparelho psíquico primitivo no feto. Assim, foi possível supor que durante o período pré-termo esta descarga de energia catexizada poderia se projetar diretamente sobre as estruturas cerebrais límbicas e motoras e deixar traços de memória inconscientes das experiências da vida intrauterina. Seriam estas influências de natureza psíquica em conjunto com os fatores epigenéticos, que contribuiriam para o aparecimento de certos transtornos comportamentais e do neurodesenvolvimento. Sendo assim, sugerir uma abordagem transdisciplinar precoce em bebês de risco expostos a fatores estressores ambientais ou epigenéticos durante o período gestacional, especialmente durante a janela de plasticidade sináptica, proporcionará uma oportunidade terapêutica através da reorganização psíquica e da integração sensoriomotora.

Palavras-chave: psiquismo fetal, sinaptogênese, neurofísica, psicanálise, neurociência comportamental, desenvolvimento fetal.