

## PSYCHOTHERAPY IN 21<sup>ST</sup> CENTURY

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### SUMMARY

**Introduction:** Today, psychological processes and brain is no longer looked at as something less scientific in comparison with physical processes, so mental diseases will become equal as physical diseases very soon. Until recently, brain functioning could be observed only in patients with cerebral lesions, after surgery, and on animals, but it is possible today to observe it directly with modern imaging techniques.

**Aim:** The aim of this presentation is to point out that optimal health and functioning, which are basic assumptions of both neuroscience and psychotherapy is related to increased level of integrity and neural networks growth.

**Methods:** Therefore, neurological development can be seen as development determined by experience. More neural networks will be developed during critical periods then, ultimately, will be used. Environment in which child lives and develops determines which networks are going to live through, and those that were not stimulated are susceptible for neural extinction (pruning). Quality of parental relationship has basic impact on brain development. Mother's capacity to regulate newborn's affects is directly linked to future child's capacity to regulate his/her own affects.

**Results:** Positive experiences from an early childhood, together with positive genetic heritage, ensure proper brain development. First years in human life are also a period of most turbulent brain development, and those early experiences have disproportionately large impact on human brain development.

**Conclusions:** Brain growth and differentiation are not only determined genetically but also with constant interactions with environment. This epigenetic brain information doesn't end in an early childhood. There is a lifelong redistribution of cortical networks, depending on individual experience, including creation of de-novo generation of neurons in adult hippocampus, as recently proved, and neuroplasticity is precondition for any persisted behavioral change, behavior, cognition and emotion.

**Key words:** psychotherapy – neuroscience - neuroimaging

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### INTRODUCTION

Human brain is an 'organ of adaptation' to the social and physical world; it is stimulated to the growth and learning through positive and negative interactions with an environment. It is also well equipped for using stress and anxiety to form new knowledge, and at the same time it can overcome short stressful periods without negative consequences. Ever since birth, our brain is being formed by stress in a way of memorizing experiences necessary to survey. Fortunately, most of our experiences are not traumatic but more subtle and unconscious (Damasio 1999).

Brain's most important task is to keep individual alive, and another task is to enable individual to manage body in it's interactions with a world and environmental occurrences, whereby all living creatures are genetically equipped for those activities. People are continuously overwhelmed by numerous stimulus, whether it is information within own body or from environment (noise, light, temperature, etc.), and CNS's task is to accept all the information and recognize significant ones, crucial for survival, all based on heritage on the one hand and gained experiences on the other.

Brain is programmed to keep balance and, when faced with new experiences, it processes and estimates unconscious/subcortical and conscious/cortical (Cozolino 2002). Events stored in a brain based on earlier experiences don't cause significant reaction, while smaller stressful events cause mild arousal. However, if

events are not even close to prior ones, they can become potential threat and need organism to prepare defense. On the other hand, too stressful events can move reaction into the wrong direction which can lead to irreversible changes in organism. When exposed to stressful situation, organism releases stress hormones and primitive responses in 'fight or flight' form. Exposure to a large number of information which can't be processed and understood can result in stress stimulus (Kandel 2005).

Every person has his/her own way of reacting and own personality traits. Many outside events, environmental events, impact person and activate his/her reactions, produce new reactions and change person. New acquaintances, marriage, new born, disease, death of beloved one, war... it all have significant impact on person. It is also a fact that events inside us, our inner life, personal experience, feelings, emotions, our aspirations, fantasies, steer is and impact our behavior. Person's inner life is very rich and important source for his/her actions and reactions, for his/her behavior. Emotions, wishes and fantasies are in constant movement. This constant movement of an inner psychic life is called psychodynamic work. Psychodynamic understanding of personality reveals our thoughts, emotions, our wishes and fantasies that impact, move and change our behavior.

Sigmund Freud (1896-1935) believed that every one of us has certain psychic energy made by innate impulses and law of preserving energy is applied (Freud

1954). Economy perspective includes distribution, transformation and consumption of emotional energy. Instinctive impulses function by pleasure principal; they request momentarily discharge (fulfillment) so there would be less tension. This way of discharging energy is called primary process because it is believed that is original way of psychic mechanism functioning. It is hidden and masked, and it's manifested in dreams and psychiatric symptoms. Sigmund Freud believed that primary thinking process 'doesn't take in consideration usual limitations of outside world and social environment', but, on the contrary, ignores limitations set in time and space. Primary thinking process is seen in allusions, analogy, fantasizes, and especially in poetry, wits and jokes, dreams and symptoms (Freud 1953).

Human brain is formed by external stimuli and experiences with selective stimuli of neurons which, under those influences, mutually connect forming neural network. Early development is connected to excessive neuron generation, neural plasticity, but over time their number is being reduced by pruning and apoptosis. Synapses created in those processes are gradually being eliminated if not used or not effective enough.

Human brain develops from three vesicles which stand out on cranial part of neural tube in 4<sup>th</sup> week of embryo life. Frontal vesicles are called prosencephalon, medium are called mesencephalon, and postern is called rhombencephalon. In 6<sup>th</sup> week of embryo life presencephalon is being divided in two: telencephalon and diencephalon. Rhombencephalon divides in a same way: metencephalon and myelencephalon; and mesencephalon stay undivided. Ultimately, five vesicles, from which certain parts of brain develop, emerge from originally three vesicles; they change their appearance during evolution, but basic relation stays pretty much the same (Thacher 1980).

Human brain is basically consisted of tree sections: brainstem, limbic system and cerebral cortex. Brainstem represents bisector that reflects human inner life: temperature, heartbeat and basic reflexes regulation. Limbic system is comprised in emotions, learning, memory, modulating of primitive response of approaching and avoiding (Patterson 2003). Cortex organizes sensorium, motor, conscious experience, as well as our learned relations and interactions with an environment. Greatest part of cortex depends on experience while brainstem is defined by genetic heritage (Thacher 1987).

Human brain has two basic functions (Cozolino 2006):

- Brain's first function is communication; brain communicates with eyes, ears, mouth, space around body and nerve-cell endings all over the body, that way receiving sensory information from environment. Afterwards that information is being sent all over body via spinal marrow and peripheral nervous system. At the same time, central nervous system receives information from body and, after processing and planning, sends them back to environment. These signals can be intentional (speech, writing,

signalizing) or unconscious (blushing, heavy breathing, pupil constriction).

- Brain's second function is integrating sensory information with priory stored information in conscious and unconscious memory.

Neurologist Paul MacLean (1990) established that human skull contains not one but three brains, and each one represents separate evolution level which was developing above elder levels. Structure and organization of human brain is a result of evolution which shows progressive growth and development of the brain while characteristics of evolutionary earlier ancestors were retained. MacLean wrote that human brain functions as three mutually related biological computers, each having its own special intelligence and subjectivity, its own experience of time and space and its own memory. The oldest and most primitive brain is brainstem which is responsible for vital functions of survival, such as rhythm of sleep and vigilance, hearth rhythm, breathing, keeping body temperature. Striatum or basal ganglia is continuing on brainstem which connects brain with evolutionary ancestors, reptiles, and this region is responsible for routine motor forms of behavior, such as bike riding etc. These motor functions are stored in basal ganglia I they can be automatically activates as routine at any time. Limbic brain or elderly mammal's brain (paleo-mammalian) which includes midbrain and thalamus is connected with emotions and memory, but also with unique mammal's behavior such as parental care, game. Highest and most developed level is called neo-cortex or younger mammal's brain (neo-mammalian) which includes, in humans as well, most developed part of prefrontal cortex. This part, 'executive brain', is responsible for planning the future, commitment to an assignment, and finding ways for problem solving, postponement of comfort and gratification, affect regulation, planned movement control, as well ad control of emotions, behavior and physiological processes of 'lower', more primitive regions (MacLean 1985).

Brain development is different in different animals, which refers to probable development of human brain during evolution. Some of primitive structures (limbic part of brain), situated in middle part of the brain, also called sub-cortical part, can be found in some more primitive species, such as rats, and this structures include hippocampus, amygdale, hypothalamus and thalamus. These structures include basic life functions necessary for survival. Cerebrum becomes more differential and larger as species develop, and in humans it reaches its maximum, while prefrontal cortex is most development and it's what differ us from apes (Taylor 1999).

Left and right brain hemisphere, limbic system and cortex develop gradually during evolution, by insuring specialization to particular parts of brain (Thacher 1987). Two brain hemispheres mutually communicate primary via corpus callosum whose long neural fibers connect appropriate and corresponding regions of right and left hemisphere while involvement of both hemispheres is

responsible for most of brain functions (Solms & Turnbull 2002).

Human brain continues to develop even after birth and in first five years brain volume increases while grey and white matters increase as well (Kostović et al. 1988). From 7<sup>th</sup> to 17<sup>th</sup>, progressive increase of white matter and decrease of grey matter occurs, while there are no changes in brain size, but frontal and parietal parts of cortex, volume of hippocampus are being significantly increase, and corpus callosum is being decreased (Giedd et al. 1999). During period from 20<sup>th</sup> to 70<sup>th</sup>, size of diencephalons as well as grey matter volume are gradually decreasing, primary in temporal and frontal cortex, while there are no changes in white matter and hippocampus volume (Sullivan et al. 1995). After 70<sup>th</sup>, mild reduction of hippocampal volume, cerebral atrophy, and reduction of grey substance, reduction of temporal volume and increase of ventricular volume occur (Siegel 1999, Sowell et al. 2003, Šimić et al. 2005)].

Growth process of new neurons, neuron-genesis, is becoming more significant subject of neuron-scientific researches, and prior believes that we are born with defined number of neurons and disability of replacement for lost neurons after birth is gradually being abandoned (Huttenlocher 2002). Modern brain imaging techniques (MR, PET) show process of neuron-genesis in hippocampus, and probably in prefrontal cortex as well, regions that is exceptionally significant for human psychological functioning (Imayoshi et al. 2008, Saxe et al. 2007, Ge et al. 2007, Meshi et al. 2006, Lledo et al. 2006).

Functional centers in brainstem organize basic behavior that makes sure that organism survives, such as feeding, drinking, defense mechanisms, mach making, and reproduction. Brain originates and shapes basic behavior using brainstem and complicated network of higher brain functions which includes attention, orientation, perception, complex learning, memory, strategy, planning and action, concept and judgment forming, speech and language.

Limbic system, placed under and around cerebral cortex, represents neural base for emotions in which process amygdale has crucial role by giving emotional valence (safety vs. danger, good vs. evil) (Panksepp 1998). Hipocampal system, also linked to frontal cortical area, adds an experience context. Emotional memory (implicit) is unconscious, while contextual memory (explicit) is approachable to consciousness (LeDoux 1996). These two memory systems are separated, but they usually act together in ensuring high quality memory in which process the frontal lobe has significant role in integration of information coming from amygdale and hippocampus.

## AIM

The aim of this presentation is to point out that basic assumptions in neuroscience and psychotherapy are that optimal health and functioning are linked to increase of integration and growth level of neural networks. On

neural level, integration and communication of neurons is linked with feelings, cognition and behavior. On psychological level, integration is characterized by possibility to resolve experiences of important life situations by including minimum defenses (Cozolino 2002).

Freud wrote (1920): ‘Deficiency in our description will probably disappear if we are already in position to replace psychological terms with psychological or chemical terms... We could expect (in psychology and chemistry as well) to give amazing information, while we cannot guess what feedback will be in a few decades, what answers will be to questions that we asked. Answers that will come could wipe out all our artificial hypothetical structures (Freud 1920).’

Almost hundred years later (1999), Eric Kandel, Nobel price for medicine winner, wrote: ‘When therapist talks to a patient, and patient listens, therapist doesn’t only make an eye and voice contact, but also starts whole neural network in his brain that has indirect and, hopefully, long term effect on patient’s neural network, and, most likely, vice versa. For the time being, while words make changes in our patient’s brain, it’s probable that these kind of psychotherapeutic interventions make changes in a patient’s brain as well. From this point of view, biological and socio-psychological approaches are unified (Kandel 1999).’ Freud has connected individual development with evolution of species. Ontogenesis repeats phylogenesis. Cortex, although active since birth, develops slower than other brain regions. Slow brain development allows impact of environmental factors, but an impact of transgenerational transmission of experiences that ensure individual’s survival. Dependence on a mother ensures survival to primates and ensures time for higher brain structures (neo-cortex) development.

## METHODS

Positive experiences of an early childhood linked to good genetic heritage ensure correct brain development. First years of life are also a period of most tumultuous brain development and early experiences have disproportionately big influence on human brain development.

Modern neuron-scientific researches indicate that brain development doesn’t end with birth. Brain contains almost all of neurons, but their connection (synapses) is not yet established; during first two years excessive synapses production occurs, especially in prefrontal cortex which is responsible for emotion and verbal learning regulation. During lifetime synapses that were not used gradually die and their number in adult brain stabilizes at approximately  $10^{14}$  neural networks (Schoore 2003). This way, PFC development depends in environmental stimuli, and early childhood experiences determine neural networks in cortex which stabilize over time. Presence of caring parents (or guardian) is necessary for development and ability to make relations with other people, as well as development of language, capacity for empathy and emotion regulation.

In ethical terms it is not possible to study impact of an early emotional deprivations and stress stimuli on human brain development, but studies of experimental animals (apes) indicated necessity of mother's presence for normal behavior and normal development of CNS (Schoore 2003). Experiments showed that apes' newborns, separated early from mother, even in presence of their surrogates (wire-dolls), didn't function in a same manner as ones without this kind of experience. Animals being separated from mothers from birth to 6<sup>th</sup> month had significantly lower level of noradrenalin in cerebrospinal liquid then ones not separated from mothers, and the level of noradrenalin did not normalized even after mother's return. Likewise, in experimental animals reduction of synaptic networks occurred, in which process postsynaptic hypersensitivity occurred, manifested in excessive response to stimulus. Mild increase of noradrenalin in cerebrospinal liquid, stimulated by stress, resulted in excessively aggressive reaction (Zuckerman 2005).

Similar consequences can be seen in human, such as consequence of 'isolation syndrome', and they can be manifested with autism, schizophrenia, and some types of antisocial personality disorder. Even today it is still unknown what kind of damages occurs in brain of children exposed to abuse and extremely traumatic experiences in an early childhood. Modern studies of children (Rutter et al. 2001) raised in very inappropriate orphanages in Romania during time of Ceausescu, indicate that this children, despite of appropriate care and love from their adopters, have permanent disturbances in functioning and behavior later in life, accompanied by permanent changes in brain structures as well (Chugany at al. 2001, Mehta et al. 2009).

## RESULTS

In past decade, understanding of interaction between genetic and environmental factors in brain development is significantly extended. Genetic influences are no longer seen as unchangeable, it is now determined that internal and external stimuli are included in brain development, such as hormonal factors, stress, learning and social interaction. These factors change binding of transcription regulator in DNA regulatory regions, influencing the speed of code region translating its own genetic information and influencing on making compatible proteins. Accordingly, transcription is susceptible on environmental factors, and this process is called epigenetic regulation. This is one of many ways that show brain development susceptibility on social influences. Through its pattern function, genes create basic functional brain anatomy, but transcriptional gene function, dependent on internal and external environmental factors; determine how genotype will transform to phenotype, depending on development.

Neurological development depends on experience, in which process enriched environment leads to increased mitochondric activity in neurons and to larger

number of synaptic networks. There are also critical periods in neurological development in which increased growth of some parts of the brain occurs and, at the same time there is increased susceptibility to presence or absence of environmental stimuli. For example, development of speech in children during second year, followed by relatively fast development of the right hemisphere as well as parallel fast development of sensory, motor and emotional capacity, and simultaneous development of parts of the brain responsible for emotional regulation and establishment of emotional relations with objects (Cozolino 2006).

Recurrent experiences from an early childhood in social environment are being stored as mental representations of personal experiences with significant others (mother), and matching emotional accompaniment (affect) follows this social interaction and experience (Emde 2000). These representations appear as combination of thoughts and feelings which have their individual social meaning, but also their neural (biological) base. Social and psychological experiences are internalized as permanent, but primary individual modification of nervous system (Tyson 2002).

Neurological development can be seen as development dependent on experience. More neural networks appear during critical periods than ultimately it will be used. Environment in which child lives and develops determine which neural networks will survive, and those that were not stimulated enough are susceptible to neural death (pruning). Quality of parental relation has basic impact on brain development. Mother's capacity for affect regulation is directly connected to future child's capacity for own affect regulation, and development of 'social' brain between 18<sup>th</sup> and 24<sup>th</sup> month is conducted by compliance of relation between mother's right hemisphere and child's right hemisphere (Schoore 2003).

The most of emotional and interpersonal learning takes place in first few years of life, at the time of 'primitive' brain structures domination (Tulving 1985). The most part of learning takes place before there is necessary conscious memory system. This is the reason why most important functions for survival are controlled by reflexes, behavior and emotions learned outside of our consciousness. Control of basic life functions is established before birth. During first year, neural network is established, but it's not yet in compliance with coordination of this network function.

Fuster (1995) emphasizes that, at birth, every central nervous system is phylogenetically gifted with specific instinctive responses, 'species' knowledge' (Fuster 1995). Newborn's first observations occur in a context of this phylogenetic understanding of the world and internal needs. These first observations, which supplement and impact phylogenetic knowledge, lead to learning or memorizing which are located in neocortical and sub neocortical neurons. This observation is never 'clear' it always appear in neural context impacted by learning – whether this learning was phylogenetic or individual.

Learning impacts neocortex cells which impact observation. Therefore, memory and observation overlap both physiologically and biologically (Andreasen 1997).

Memory is important for learning processes and changes that are tool in psychotherapy (Cozolino 2006). Distinction arisen from neuroscientific discoveries on two memory systems is especially important: gradual/procedural (implicit) memory which includes all automatic deeds, unconscious designation and nonverbal routine behavior, while declarative (explicit) memory records individual experiences for later recall. Both are based on involvement of different structures: implicit memory includes, among other, basal ganglia, cerebellum and amygdale, while declarative memory is mostly located in temporal lobe, especially in hippocampus and cortical structures connected with hippocampus.

Researches of mother-child interaction indicated that gradual learning and brain functioning of interaction models are fully developed in children at age of 3-4 (Chiron et al. 1999). By unconscious processing of affect information their system of implicit memory is ready for extraction of prototypes and rules from repeated experiences. This way, procedural 'being with schemes' require organizing child's interpersonal behavior, which will later be transferred to other environments, regardless on their accordance with earlier experiences. Thereby, implicit memory system also represents link between poor experiences of early interaction, dysfunctional models of binding and disturbed affect regulation, which has a lead role in most of mental disorders.

Internal experiences that appears naturally along span whose poles are pain and pleasure, caused by either internal either external objects or events, become involuntarily nonverbal signifier of comfort and discomfort (Damasio et al. 2000). In earlier states of evolution these states, including all states classified as emotions, were completely unknown to the organism which produced them. These states regulated life functions, causing some internal and external activities, and that was enough (Schulkin et al. 2003). But, organisms producing those states weren't aware of their existence, because they had body and brain, but not awareness. In these organisms there is being, but not cognition of being since there wasn't any consciousness yet (Panksepp 2003).

Consciousness occur when brain gets an ability to talk about being and changes which occur in meeting objects and events in environment, as well as possibility to talk about thoughts from internal processes of life (Emde 1999). It is part of the whole, almost indescribably long story of hominid and human evolution and represents the unfolding in individual humans of genetically based and culturally enhanced strategies for our survival. Trial and error, inventive tinkering and design, major innovations in brain operations to transform two hands into a cooperative pair, and to permit the hands to signal, reach, and even tell stories

through mime and gesture all became part of the evolutionary success story of the hominids with their new hand and expanding brain. A feeling of one self occurs as feeling emotion (Wilson 1998).

Children learn by being brought up in the company of parents, other adults, sibs and other children, from the toys they are given and the games they are taught to play, and from the behavior of an infinite variety of objects grasped and manipulated in their hands. They already understand how to learn from others, and how to teach themselves, by the time they reach school age, but schools can change the learning process for children in profound ways. Most of these are positive, but there are dangers as well; for example, the process can easily be divorced from family and community life, or the school can substitute an approved list of adult career goals for the child's native curiosity as a prime mover behind his or her personal search for skill mastery and understanding.

Although brain growth and development proceed on all levels of neural processing, language seems to represents key mechanism of integration. Linguistic area in brain's left hemisphere enters its critical period in second year, in which process grammatical language of brain's left side integrates with prosodic elements of communication developed in right hemisphere (Schore 1997). Cortical language centers' development gives words a meaning and words gradually arrange into sentences which can express more complicated ideas, thoughts and emotions.

Development of frontal lobe creates more and more memories. Sense of time gradually relates with autobiographic memory, coordinates with place, event and one self in time framework (Bell et al. 1999). Talking emerges form process of combining events and associated emotional values, and all of organizing in creation of nascent self experience. Stories connect stimuli, thoughts and activities in a manner of creating inner and external one's world. This autobiographic memory becomes core of human sense of history, human conscience and relations with others, and human cognition of one self in interpersonal and physical space (Fink 1996).

It is well known that, before we develop ability of linguistic understudy of information/speech, nonverbal communication leaves deep impression on personality development. Children learn by observing pattern – observing others, and mirror neurons could be key explanation how does it happen on neurological level. Developmental studies of behavior indicated that gestures are very closely connected to lingual expression – we gesticulate even when we speak on the phone (Gallese et al 1996 & Petitto et al: 2000).

Speech development is also gradual; it starts with inarticulate noises to reach its final form and intelligibility for others. Speech development is connected to human evolution and with gradual creation of larger groups which needed some form of communication to survive dangers they were exposed to. Speech develop-

ment was simultaneously accompanied by human brain development, especially corresponding brain sections, by using more complicate forms of symbolic and abstract communication. Formation of facial expression, gestures, hand movements, speech development and word usage is connected with a need for more efficient relation to others and with more-quality social relations, but also more-quality way of information exchange (Dunbar 1996).

Recently, so called 'mirror' neurons were discovered which doesn't activate only by performing certain action, but also just by looking (observing) at this action (i.e. motor activities of others), and they were discovered by method of functional magnetic resonance (fMRI) in areas of cortex in charged for planning and execution of motor activities (including linguistic ones), e.g. large areas of pre-motor and vertex cortex (Koski et al. 2003, Iacoboni et al. 2001). During action observing they come out only if the action is taken by biological subject (e.g. hand), in which process pre-motor cortex activate in so called 'somatotopic' way. Parietal cortex activates only if action is made on an object (e.g. taking a pencil), while activation of pre-motor cortex doesn't depend on object. Mirror neurons were discovered in 1990ies by Gallese and Rizzolatti at the University of Parma (Gallese et al. 1996 & Rizzolatti et al. 1996).

It seems that there are speech areas in Broke's area, which includes so called Brodman's areas BA44 and BA45 in left hemisphere, in lower frontal gyrus and, besides speech, it represents hand movement as well (Bonda et al 1994). Using functional imaging (fMRI) and magnetoencefalographic brain representation it is confirmed that Broke's area and pre-motor cortex are active during hand movement, as well as observing similar movement in others (Heiser et al. 2003). Researches also indicate that excitability of motor cortex on a hand increased during reading out loud in dominant hemisphere. However, this kind of impact is noticed in non-dominant hemisphere in patient with stroke who partially recovered from aphasia caused by stroke. Therefore, after stroke cortical reorganization and inclusion of non-dominant hemisphere in speech creation occur (Nyberg et al. 2001).

Although interpretations of fMRI in patients with aphasia are contradictory, there is consensus that in these patients right hemisphere is more active than in healthy individuals (Mestu et al. 2004, Seigher et al. 2001). It is explained by decrease of transcallosal inhibition in dominant hemisphere. Besides, data on the fact that patients with aphasia can't recognize hand movement in pantomime also indicate connection between area for hand movement and linguistic area (Bell 1994).

Answer to the question why do area for hand movement and Broke's area coincide, we can seek in results of primate studies (Arbid 2002). Cortical area F5 in apes is a part of frontal area and it correspond with Broke's area for language in human (Dunbar 1992). It includes, besides hand area, area for mouth and face and

by stimulating it hand and mouth movement are being stimulated. According Rizzolatti's and Arbib's theory, area that was prototype of F5 area had a key role in communication via face and hand gesticulation (Rizzolatti et al. 1996, Rizzolatti & Arbid 1998).

Meaningless sounds gradually gained specific meaning and system of 'mirror' neurons which coordinates hands and mouth movements became basis for speech evolution. In accordance with this theory is also a well known tandem of gesticulation and speech in human (Arbid 2002). It was also proved that people who stutter stop gesticulating when they start to stutter, and it re-appears at the same time as fluent speech does. Further more; in bilingual children hand movement related to speech develop simultaneously with development of each language. From above mentioned we can conclude that 'mirror' neurons in human include at least Broke's area, primary motor cortex and cerebral cortex of parietal lobe round the tip of upper temporal lobe, and Broke's area coordinates activity of this system (Gallese 2001). It seems that Broke's motor area for speech appeared and lateralized with increase of neighboring area of neurons specialized for right hand movement (Lieberman & Mattingly 1985, Rizzolatti & Arbid 1998).

Where are beginnings of human speech? Speech starts with combining sounds and movements, which explains why functionally gestures, movements and speech are connected in brain, and during evolution these regions developed and took over function of speech control. Development of semantic abilities gradually overcame need for gestures and sonorous communication, and human need to gesticulate while talking is a result of this evolutionary process.

Speech is also tightly connected with anxiety and fear. Stressful situations derive emotional response and activate relevant cortical regions which stimulate or inhibit human activities and interests, but simultaneously lead to cognitive and behavioral abilities development, as well as speech acquisition. Frustrations and stressors create split between emotions and cognition, and speech can be seen as a bridge between these two aspects. This split or fault point, the place where feelings lie behind cognition, determines our humanity. Specific human feelings, such as anxiety, appeared at the moment when human ancestors lost their emotional reaction in biological instinct and substituted this loss with symbolic regulation and control.

Human speech, combined with emotional synchronization, creates ability for supporting neural growth and integration. The child doesn't have an ability to understand own internal life if he/she has been left in silence due to their parental inability to verbalize internal experiences. Ability to speak is necessary for integration of neural structures and organization of experiences on a conscious level, and if the child is abused or abandoned, neural organization and structuring get's disturbed (Decon 1997).

Parent-child conversation, in a context of emotional relation compliance, provides basis for narrative ability and story telling. Media through which the child's brain gets an opportunity to integrate various aspects of experience in coherent form is insured when verbal interaction also includes relevant feelings, behaviors, thoughts and sensation. Autobiographic memory improve self-consciousness in a way that includes processing through multiple neural networks, enlarges ability to face problems and allows us to deal with stressors and to control our feelings (Decety & Chaminade 2003).

Social participation is main activity from which we learn since childhood. Through social activities we mostly unconsciously internalize (adopt) activities, habits, vocabulary and ideas of members of a community in which we live – imitation and identification are superior way of learning in a way that, throughout evolution of human brain, they overpowered all other learning forms (Stern 1985, Byrne & Russon 1998, Fadiga et al. 2002). Imitation and identification include memory system development, primary procedural memory, mirror neurons development, imitating behavior, prolonged dependence on parents which allows imitation and coordinating, as well as mentalization process which is characteristic for human kind (Ohnishi et al. 2004, Rutter & Sroufe 2000).

In a last decade understanding of genetic and environmental factors was expanded; in which process cca 60% of all of our genes participate in brain development. During nine months of pregnancy and few months after birth brain development is mostly under influence of genetic code, such as processes during which cells migrate from primitive neural tube to their final location or, after migration, making a temporary networks that create base for final networks. Equally, myelination process is genetically conditioned, it ensures faster impulse implementation through axons, in which process takes place primary in prerogative sensory areas, and myelination process takes place in prefrontal cortex which is responsible for higher cognitive functions and it starts three months after birth and continuous until adolescence (Rutter 2000).

On the other hand, genetical impacts are no longer seen as irreversible but it is confirmed that both internal and external stimuli are included in brain development, such as hormonal factors, stress, learning and social interaction (Manolio et al. 2006). These factors change binding of transcription regulators in regulatory regions of DNA, so it impacts the time that's needed for coded regions to translate their genetic information and impact making relevant proteins. Accordingly, transcription is susceptible for environmental factors, and that is the process called epigenetic regulation. This is one of many ways which show susceptibility of brain development on social influences. Genes create basic functional brain anatomy through their pattern function, but transcriptional gene function, dependent on internal and external environmental factors, determine the way genotype transforms into phenotype, depending on

development course (Manolio et al. 2006, Hickmontt & Ethel 2006).

## CONCLUSIONS

Healthy human brain and psyche development requires adequate environmental conditions, and it is not enough that the child is worm, clean and fed in order for his/her brain and mental functions develop spontaneously. During first years, human brain goes through intensive activity stages followed by numbers of critical periods which reflect number of directions in creating communication between various brain regions. Cortical development's critical periods depend on experiences and environmental stimuli, and they are most pronounced during first years, but they continue affecting all through lifetime, although their impact on adult brain scientifically decreases.

The earliest child-environment social relation, especially one with mother as a primary object, determines later child's relation with external world. Early experiences impact neural connections which are biological substrate of personality, adoptive abilities and strength, that is, susceptibility and vulnerability which can appear later in life in some form of pathology.

Newborn's brain is well equipped with large number of neurons, synaptic potential and dendrites, and genes are responsible for intrauterine, early brain development and forming. But after birth, child's experiences determine which neurons will survive, which synapses will develop and stay permanently, which neural networks will stay active and which ones are going to deactivate. Myelization, which creates protection round neural fibers, continues during childhood till third decade, and final product is ultimate forming of brain structures (Hickmontt & Ethel 2006). Brain alterations induced by these changes, cause significant health problems. For years scientists ignored potential influence of early traumatic experiences on diseases in adults, and genetic factors or exclusively biochemical factors were in the forefront, excluding influence of experiences. New scientific evidence indicate significance of impact of childhood early trauma from on brain's physiology, and education of medical doctors in recognizing mental health protection in children, preventing violence and abuse, becomes more important every day (Lee & Hoaken 2007).

**Acknowledgements:** None.

**Conflict of interest:** None to declare.

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