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Neuropsychological Context of Marital Functioning

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1. Introduction

Current achievements in neuroscience prove that when it comes to human behavior, human brain is responsible for solving social problems by activating psychological executory mechanisms aimed at specific problems, which developed thanks to the processes of natural selection. This kind of approach assumes modularity of brain's functioning. The modular approach posits that brain comprises of modules of different and diverse neuronal centers and processes and mechanisms for solving different social problems connected to them. And so for example learning processes or different forms of cognition work accordingly to different principles or rules, by using different complex neuronal structures and programs to process information; for example, different ones about words, others about faces or another ones about smells, and about sounds, etc. In that way a modular approach understood assumes that people can notice, remember and evaluate information in different ways and also decide on different ways of using it to carry out different social goals (Sundie et al., 2006). This particular propriety has an important meaning for explaining and understanding complex social processes in general, and in particular, for functioning of an intimate relationship, for example a marriage. This is why the issues concerning marriage and family should be also examined in a multisystem context of the life of its members. However, in practice and in a traditional approach, researching and investigating this phenomenon is limited to socio-cultural macro-systems in which those institutions function. What is usually not taken into consideration is the micro-system level of analysis that includes internal experience of the partners or family members seen as a class of brain processes. Thanks to dynamic advancements of research techniques, the scope of neuropsychological knowledge widened significantly in the last years, enabling a better and broader understanding of human brain functioning and its influence on all the forms or signs of human psyche and behavior that take place in close interpersonal relationships, and more particularly in marriages. It is thus not surprising that some researchers propose to describe it as 'interpersonal neurobiology', consequently underlining the meaning of relation between the interpersonal relationships, emotions and the brain. Understanding the key concepts of social neuropsychology can significantly enrich the work of psychologists on the problems of married couples or families both in theoretical, as well as in practical aspects, and mostly in the therapeutic aspect and even clinical one (Fishbane, 2007; Atkinson, 2005).

Human brain that is equipped with millions of neurons, connected with each other with billions of chemical synapses, is the most complex unit in the Universe. What is more important, those connections create neuronal circuits, that form neuronal networks in different parts of the brain. Activation of those circuits in specific, but different areas of the brain, causes an appearance of specific but diverse processes of thought, emotion and action, since, as it turns out, brain functions in a modular way. It must be noted that experiences which originated in interaction with the environment, influence the development of the brain through changes or through creating new connections in already existing neuronal circuits during the whole lifespan of an individual, thanks to the neuroplasticity that is characteristic for the human brain. Especially early experiences coming from the relation parent – child can indirectly modify the activity of genes responsible for the development and forming of particular brain structures. This process is crucial for shaping of different forms of attachment. It should be noted that already shaped brain structures, i.e. neuronal circuits and neuronal networks that influence or even determine preferences, personality and strategies for acting and for keeping oneself alive, were activated and included in circuits early on and are not very prone to or are even resistant to change, as they are the neuronal basis of habits, that allow for relatively permanent and predictable forms of actions and behaviors (Ito et al., 2007; Cunningham , Johnson, 2007; Goleman, 2006).

In close interpersonal relationships, especially marital ones, the key role is of the emotions-feelings-affects. It should be also noted, that neuronal structures responsible for human emotions are not localized in one, singular area of the brain, but contained in numerous interconnected circuits . The majority of the information on the emotional sphere is processed unconsciously and subcortially, mainly in the limbic system. Usually one is not aware of the fact that emotional processes take place during real-time in one's brain; only after they reach the level of cortex one becomes aware of them and they are properly interpreted as specific pieces of data originating in structures of the limbic system and in other brain structures, or even in other structures of the rest of the body. Because of that, in terms of neuroscience there is a distinction between emotions and feeling and affects. Emotions, being an evolutional adaptation, are unconscious and are linked to somatic processes, i.e. somatic expressions typical for each of the emotions - mostly facial expression and body posture; as stated by LeDoux (1995) emotions 'are full of blood, sweat and tears' and mostly happen on a subcortical level. It is worth mentioning that the commonly found emotions are: love-concern, joy-happiness, sadness, fear, disgust, surprise, anger. While feelings have a character or a form of emotions' content, however, what is important, are processes on a cortical and conscious level without the accompanying somatic processes. Humans have a limited ability to define their feelings; so far around 35 feelings were named. A neurological case of lack of the ability to identify or utter the emotional content in a form of feelings is known as alexithymia. While the affects have a processed, mostly on the level of prefrontal cortex of the frontal lobe, content form of feelings connected with a system of values and aims and with a clear influence on behavior and actions of an individual, affects also lasts longer; they are one of the executive functions of the prefrontal cortex. When examining the course of processes of emotional stimuli of the emotions-feeling sphere, what must be taken into consideration is the so called bottom way on the level of subcortical structures and after that a transmission to the cerebral cortex, i.e. 'bottom-up' and an upper way on the level of the cerebral cortex and transmission of the information to the subcortical

structures, i.e. 'top-down' (see: Rostowski, 2007). What is very important for the parameters of interpersonal relationships is not only the capacity but also the ability to adequately communicate to each other the positive feelings. However, in this respect, there are individual differences partially determined by inherited-genetic factors, as for example in the case of introverts and extraverts (Morris, Cacioppo, 2007; Fishbane, 2007; Liebermann, 2007; Ochsner, 2007).

As aforementioned, social neuropsychology, in a detailed way, includes forms of social behaviors of individuals, although with a close relationship or a strong reference to functioning of particular brain structures, i.e., specific neuronal circuits. Within a framework outlined above, what will be considered in this part are some of the more important forms of behaviors in married life and their possible influences on the functioning quality of marriages or other interpersonal relationships. The forms of social behaviors studied here, can be different depending on whether the particular brain structures were formed properly or improperly, whether they were shaped in a disturbed way and with deficits and, which defines or determines the expressions or forms of behavior as either correct, socially acceptable and expected or incorrect, poor, visibly disturbed and pathologic, influencing the quality of functioning of partners in a marriage or in other interpersonal relationships.

Using this approach, in this chapter, the following processes will be examined: self-control, imitation (simulation), empathy, self-knowledge, mind reading (mentalization) and the role of mirror neurons in perceiving oneself and other people – as the direction of their development and the levels of their intensity decide, to a big extent, on the character of the relation between the partners of interaction and thus on the quality of functioning of a marriage.

2. Self-regulation

A very important human ability in civilized societies, and even more so in institutions or social groups, and especially in close interpersonal relationships, like marriage, that are characterized by a need of constant interaction between the partners – is the ability to regulate and control one's thoughts, feelings or actions. This approach considers self-regulation as higher level executive control, i.e. concerning executory functions like: predicting, planning, setting goals, restraining or consciously planning actions, executing, concentrating, working memory, making choices or decisions, naturally, in relation to lower, first level processes, i.e. subcortical processes. That being said, self-regulation mostly relates to control of emotions, feelings, instincts, needs, impulses or motivations. Admittedly, people have the ability to delay gratification and to control their inclinations-desires and to pursue goals; yet it is the failure of self-regulation in everyday life, usually intoxicant abuse-drunkenness, gluttony, different forms and different degrees of domestic violence, arguments, conflicts, etc, that is the most important and the most frequent cause of the troubles concerning marriage, family and society. It should be noted that self-regulation is also very important for all aspects of mental and physical health, and also disorders in those areas. This is why understanding the nature of self-regulation, both in the aspect of its successful implementation, as well as on the failure side, can bring valid insight into the conditions for its positive course, execution and for its failure and the potential to prevent failure from happening (Cacioppo et al., 2007; Decety, 2007; Engelberg & Sjoberg, 2005; Rostowski, 2008).

The results of social-cognitive neuropsychology studies enrich the knowledge and the understanding of neuronal mechanisms of self-regulation. It turns out that they cover three basic prefrontal neuronal circuits that are related to executive functions, that is: 1 ventromedial/ orbitofrontal prefrontal cortex, 2 dorsolateral prefrontal cortex and 3. anterior cingulate cortex. A number of processes depend on those three neuronal circuits, and especially on the anterior cingulate cortex, namely the processes connected with self-regulation of behaviors important in interpersonal relations, especially in marriages, like: monitoring the process of decision making, initiating the choice of new, but correct reaction from numerous alternatives, monitoring activities and the results of execution, detecting and generating adequate reactions in conflict situations, predicting the possibilities of making mistakes, estimating the benefits or rewards and losses or punishments, or perceiving physical, social and psychological suffering, so actions that have the key meaning in marriage and family life. Damaging the aforementioned neuronal structures or lowering their level of functional activation, causes deterioration of related self-regulation and restraining processes, that is, the processes of restrain during the interaction between the partners. And cases of severe damages can cause serious mental disorders like depression or personality disorders, mood disorders, decrease in self-awareness, emotional instability, apathy and other serious disruptions of social behaviors. That is, behaviors that affect the course and climate of everyday life, not to mention its quality. In extreme cases it can cause obsessive-compulsive disorder or even schizophrenia (Cacioppo et al., 2007; Ochsner, 2007; Decety, 2007).

3. Self-re-evaluation

When it comes to close interpersonal relationships, especially marriages, what matters greatly for correct social functioning in them is self-regulation of emotions, and especially self-regulation of negative emotions. It is worth mentioning that currently, cognitive approach perceives emotions' self-regulation as reappraisal (according to Lazarus – secondary appraisal) that lies in reinterpretation of meaning of the same emotional incident, although in non-emotional categories, but basing it on the processes on awareness level. It should be noted that using this secondary appraisal of events of an emotional-sentimental nature, can have an important impact on shaping correct or incorrect interpersonal relations within the married couple, or between the members of other social groups. The core of this process is in a way a cognitive transformation/ a change of negative emotions induced on a subcortical level with unpleasant events by reexamining them again on a cerebral cortex level in other, more objective categories of actual state, due to which they loose their primary, aversive-unpleasant character or dimension, and at the same time, an individual looses those unpleasant emotions, for example fear, anger, sadness, jealousy, etc. Neuronal structures responsible for this process of secondary appraisal of aversive stimuli is 1.lateral prefrontal cortex and 2.different areas of medial prefrontal cortex and 3. anterior cingulate cortex as well as 4. dorsomedial prefrontal cortex, that all together participate in – on one hand – cognitive control processes, and on the other – they deactivate, by restraining structures responsible for inducing negative emotional reactions, for example anxiety or depression on a subcortical level. For those sometimes negative reactions the mainly responsible structures are: 1.amygdala, 2.partially hippocampus and 3. orbitomedial prefrontal cortex. It turns out that the above-mentioned medial prefrontal cortex is basically

responsible for shaping the strategy of secondary appraisal through modulating the activity of different systems connected to processing or examining emotional states (Cacioppo et al., 2007; Decety, 2007; Ochsner, 2007; Ochsner et al., 2002).

In order to get to know and understand better the course of those two-level process-reactions when examining the role of subcortical and cerebral cortex role in emotion processing, two ways of emotional activity have to be taken into consideration that are also connected to the process of emotional self-regulation. According to the concept suggested by LeDoux (2000, 1995), that is the bottom -up way, which is a quick, unaware system, of a reactive character of processing emotional information. Thanks to that quick processing there is an 'instinctive' evaluation, basically on a limbic system level, and, to be exact, on an amygdala level, of possibility of threat, or a specific danger and activate reactions that protect individual from possible harm.. This quick protective reaction happens, among other things, through appearance of bio- or somatic markers in a form of a sometimes vague feeling, consequences, outcomes of a situation, event – in a physiologic-somatic sphere, for example sweating (that is a psychogalvanic reflex). It is mostly a way from amygdala to cerebral cortex, and so the way 'bottom-up'. However there also is an 'upper-better-main way' that is 'top-down', which means from the level of cerebral cortex structures, mostly prefrontal ones, to subcortical structures, mainly to amygdala; that lies in reaction to emotional stimuli that is reflexive, cautious, thought through and with a certain delay after which decisions are made which are more consistent with the situation (Ochsner, 2007; Atkinson, 2005; Rostowski, 2008).

Cerebral cortex structures that mostly take part in this process of 'upper way' and to be more exact in the process of emotions regulation are functions connected to 1. ventromedial prefrontal cortex and 2. orbitoprefrontal cortex. Ventromedial prefrontal cortex, together with bilateral connections with other brain areas, plays a key part in the processes of emotional-affective regulation and self-regulation. In the light of the research, it turns out that people with damages to this structure of prefrontal cortex often make social errors, take tactless actions and commit faux pas in their interpersonal actions and behaviors, due to lack of control over their own emotions and lack of recognition of other people's emotions, lack of empathy, intuition or attention, as well due to apathy, emotional instability, and lack of adjustment of autonomic functions (Decety, 2007; Lieberman, 2007). While, when it comes to orbitofrontal prefrontal cortex, what should be noted is the process of affecting amygdala in a calming and restraining way, which allows for making decisions by choosing an alternative, and as a consequence, decisions compliant or subordinated to values' system and aims, and in a broader sense to correct action strategy of an individual in interpersonal relations. In light of conducted studies, it turns out that orbitofrontal cortex can support manifestations of appropriate and correct forms of social behavior through numerous and different forms of constant monitoring of this behavior, especially in its relation to and its compatibility with social norms, as well as limiting the degree to which emotions influence cognitive processes. Cases of damage to the orbitofrontal cortex (not only structural but also functional, for example in a form of decreased demand for oxygen hypoxia, that is the so called 'Cool down' (BOLD)) can cause weakening and a reduction of this process of monitoring and insight into oneself. Thus damage to the orbitofrontal cortex limits the possibility of inducing the so called social emotions, e.g., those of shame, uneasiness or the

feeling of committing a tactless action, and others, that is emotions crucial for motivating the process of making corrections of those socially incorrect, unsuitable, improper forms of behaviors in interpersonal relationships. And so, for example, people with damages to orbitofrontal cortex, in the context of spontaneous social interactions, display a tendency not only to act improperly but also to induce incorrect emotions. The emotions strengthen rather than correct the inaccurate social behaviors. For example, in the cases of displaying forms of behaviors objectively socially unsuitable, like, among others, teasing, irritating or making fun of others, excessive criticism, humiliating and putting down others, those people as a result of this type of improper behavior, do not feel uncomfortable, but more proud of this kind of behavior, this kind of semi showing off, rather characteristic for psychopathic behaviors. Unfortunately, these types of behaviors are sometimes present in marital conflicts (Beer, 2007; Beer et al., 2006; Fishbane, 2007; Ochsner, 2007).

It turns out, that the bottom way, i.e., the way from the limbic system, allows people for a fast, instinctive evaluation of threat and protects from it, often through impulsive reactions. While, according to LeDoux, the 'upper way' from the cerebral cortex level, allows for evaluation that is less reflexive, more thought through and more connected to choice. But a fast, usually unaware or subconscious evaluation of the situation, with the involvement of amygdala, is in fact unaware, but a 'highly adaptive reaction' that holds a significant meaning for keeping one alive and for an individual's functioning, by warning him or her in time of the impending danger. The integrated combined activity of the limbic system with prefrontal cortex, especially with the ventromedial prefrontal cortex, assures emotional and relational well-being.The integrated link with orbitofrontal prefrontal cortex allows for making choices in accordance with the aims and values displayed by an individual. It has to be added, that this part of the cerebral cortex has a significant meaning in the process of self-awareness, empathy, prediction (mental vision). What is more, this part of cerebral cortex is characterized by neuroplasticity, and its development occurs during the whole life-span through keeping the ability for changes on a neuronal level. It is worth mentioning, that this kind of development change occurring at an advanced age, seems to be the basis for existence of crystallized intelligence according to R. Cattell (1963, 1971) and especially the so called 'wisdom of old age'. On the other hand, traumatic experience in the early stages of an individual's life, mistreatment, sexual abuse, exploitation or neglect can diminish the functioning of orbitoprefrontal cortex or weaken its control influence on the amygdala. Especially in this kind of cases, and even when the prefrontal cortex is developed correctly, the influence of amygdala can take over the prefrontal cortex, like in the cases of sudden overflow of emotions, so called anger furies, aggression, and can overpower conscious thinking, weakening significantly or, in extreme cases eliminating, conscious control over emotions and resulting in negative outcomes, as it sometimes happens in the case of fury – anger or aggression fit, that can also happen in close partnerships and family relationships. This is mainly the result of neuronal connections of the amygdala with prefrontal cortex (and so 'bottom – up') that are more developed than the connections from prefrontal cortex to the amygdala (so 'top – bottom'). The opposite is the case for over-activity of the orbito-prefrontal cortex when blocking of a behavior happens, a kind of 'anchoring' of behavior of an individual on one way of acting, with a visible emotional component. This kind of cases is found in obsessive-compulsive disorders (Cacioppo et al., 2007; Cacioppo & Berntson, 2005; Heberlein & Adolphs, 2007; Rostowski, 2008).

4. Simulation – Imitation

In interpersonal relations and even more so in close interpersonal relationships like marriage, the process that has a key meaning is the process of simulation, or to express it differently, the process of imitation. Imitation is a form of learning of the widest application in development, allowing for acquiring many skills without loosing time that would be needed when learning in a trial and error process. Even more important, imitation is of a core significance and plays a part in the development of basic social skills, like reading facial expressions and other body gestures, and most importantly, understanding of goals, intentions, desires and wishes of other people; overall, it plays a key part in terms of social cognition. Currently there are a number of approaches of a neuropsychological character that attempt to explain the process of imitation. In accordance with the main assumptions, recognition of the emotional expressions of another person depends, at least partially, on a type of a subsystem of the same neuronal structures that were engaged and took part in the process of the expression of this emotion. In other words, the process of recognition of somebody's emotional expression by an observer in a way includes imitation of the observed emotion in his or her own neuronal brain circuits, connected to or responsible for inducing emotions. In the process of imitation, there is a type of 'emphatic' resonance. This type of resonance can even occur on an unconscious or subliminal level (Heberlein & Adolphs, 2007, Turner, 2007: Havet-Thomassin et al., 2006). The significance of the imitation process comes from the existence of a very complex and diverse network of interactions that is generated by the social world, which challenges people. The chance to be up to the challenge depends on the abilities of members of a particular community to understand one another. This claim is even more up-to-date and important, because remaining in and succeeding in such complex relationships like marriages or other close interpersonal relationships, depends on the degree to which the partners can understand each other and read or anticipate each other's social intentions, needs and desires. It should be noted that in the last years, neuropsychology addresses this issue and gradually offers ideas for explanation of ways due to which social cognition and understanding of others is possible, taking into consideration a proper functioning of the brain. An important step was discovering mirror neurons systems, that are neuronal and cognitive mechanisms of content information transfer. It happens when the activation state of a particular neuronal network that is the basis for activity for one person, is shared at the same time by another person. This concept assumes that the systems of mirror neurons are the main mechanisms for imitation-simulation, and are one of the most important neuronal systems, thanks to which understanding or imitating other people is achieved on the level of structures of functions of the brain itself. It happens as a result of a kind of close connection and 'transmission' from one brain to the other brain (that of another person), or even with numerous other brains, affecting not only the brain but, through activation of particular cerebral structures, also the body, in terms not only of cognition but also of actions or behaviors, as it happens, for example, when somebody meets or encounters another person, especially a close one. Higher level of mirror neuron activation usually accompanies execution of a particular activity or behavior, not only its observation. What should be taken into consideration, are two levels of accordance between the observed and the executed action when it comes to the unit/pattern of activation of mirror neurons that is close one and widened one. In case of close compatibility, the set of activated neurons is almost identical in the process of

execution, as well as observing or imitating activity; while in the case of widened compatibility, the set of activated mirror neurons is not necessary the same, but similar enough that it allows for reaching the same goal; for example, a behavior of a mother and a child when greeting each other (a mother and a child behave a bit differently, but they both end up hugging each other). In the light of the neurology research results, it turns out that people's mirror neurons together with the higher visual areas in the brain structure, including superior temporal sulcus, create basic cortex circuits for the imitation processes. In this way, 1.circuits of superior temporal sulcus provide or assure higher level visual description of activity that is to be imitated, while 2. inferior parietal cortex as a second component of mirror neurons is connected to motor aspects of imitated activity and 3. inferior frontal cortex (Broca's area) is the third component of mirror neurons that is connected to recognition and the aim of the imitated activity. Though those cerebral cortex structures are strongly connected anatomically and functionally, they are not enough to explain and understand all of the activities, especially those linked to implementation of the imitation process, and even less to explain the social cognition connected to activity of mirror neurons. The participation of prefrontal cortex structures is also necessary (Jacoboni & Dapretto, 2006; Jacoboni, 2007; Fishbane, 2007; Lizardo, 2007).

It should be explained, in order to avoid misunderstandings, that those systems of mirror neurons are not the only means thanks to which a full social understanding and cognition is reached; next to those systems, to reach more complete social understanding, a semantic system is used, based on reasoning, using memory content, previous experiences, co-occurring context, etc. It should be emphasized that those two systems do not exclude each other, but rather complement one another, they are functionally complementary within the activities and executive functions of prefrontal cortex of frontal lobe (Muthukumaraswany, Johnson, 2007; Fishbane, 2007: Turner 2007).

5. Empathy

Activity of the presented above mirror neurons plays an important role in social cognition and is closely, specifically but complementary, related to empathy process expressed in close interpersonal relationships. Role of mirror neurons also assumes a paradigm of observation and imitation of body expression as well as other forms of behavior. It is known, even based on daily observation that people tend to imitate others automatically when they participate in social interaction. This phenomenon is called 'chameleon effect' or parroting. However, research indicates that the more people tend to imitate the more they tend to empathize with others. Research indicates that one way to empathize is in a way self-incorporating the face expression and reactions and body postures of others. This happens due to functioning of mirror neurons. However, since empathy process also assumes the need of emotional processing of information-stimuli, turning on the limbic system, apart from mirror neurons, also plays major role. It is important because mirror neurons and limbic system – amygdala to be precise – are anatomically linked with cortex structure through insula. It can be assumed that basic neurological base of empathy – empathizing ability consists of: 1/. mirror neurons system, 2/.insula, 3/. amygdala. It needs to be said though that depending on what category of stimuli initiates the empathy process, other neuronal systems might be activated as well. In the model depiction (with regard to emotional area) processes related to empathy in terms of shared emotions consist of: 1/.

somatosensory, 2/. frontal-parietal, 3/.premotor and 4/.motor cortex where the mirror neuron activity is particularly present and also: 5/. limbic system and 6/. cerebellum. In contrast, in the mental states domain the important structures are: 1/. inferior parietal cortex, 2/. ventromedial - prefrontal cortex, 3/. dorsolateral prefrontal cortex, 4/. medial prefrontal cortex in frontal lobe, 5/. dorsal temporal sulcus and 6/. insular and frontal cingulate cortex, and also 7/. amygdala. (Decety, 2007; Carr et al., 2002; Shamay-Tsoory, 2007). Development of these structures and their functioning level determines greatly – though not exclusively – the ability to empathize with others, so-called re-introduction and internal imitating or simulating, that is simulating of actions perceived in others: actions, facial and body expressions as well as activities performed by other body parts equipped with effectors. It needs to be added though that according to research, activity of mirror neuron system can modify the activity of other structures in this system. They are also responsible for reflecting the sensory – motor aspects of empathy (Decety, 2007; Jacoboni & Dapretto, 2006; Jacoboni, 2007; Muthukumaraswany & Johnson, 2007).

More recent research indicates that the human system of mirror neurons codes information from a broader range of behaviors and activities than it was earlier assumed. It is not reduced to motor activity or simple simulation but involves secondary expression of emotions, pain and basic somatic sensation. Facial emotional expression - observed and registered - even though not perceived by an observer, is registered by electromyography; small spasms of relevant muscles take place. Those elusive and unperceived facial expressions appear even when an individual is not consciously aware that the stimulus is presented, either because of short exposition or usage of some masking form (e.g. because of reluctance or lack of focus). Sometimes, despite those obstacles or lack of direct observation, at least vague awareness of someone around experiencing certain emotions becomes present in the form of emotional atmosphere in a given moment or the phenomenon of 'emotional contagion'. The latter means that emotions are shared through activation of an emotional mirror neuron system, above others related to facial expression that induce similar emotions in an observer or observers. Therefore, when observed faces look sad, then the observers tend to describe themselves as sadder and the other way round: when the happy, joyous face is looked at, people tend to recognize themselves as happier. The magnitude of this effect depends on strength - intensity of emotions expressed on observed faces. This data suggests that mirror neuron systems for emotions are switched on automatically in observer rather than activated by cortical centers. Therefore, the process is not 'top-bottom' but 'bottom – up'; it can be said that we do not intend to be empathic but we become so in the given situational context. Moreover, current research conducted with brain neuroimaging techniques indicates the presence of some active, neuronal and mental simulating mechanism in the process of understanding emotional states in others (Beer, 2006; Shamay-Tsoory, 2007).

And thus for actor and observer's emotion of disgust/repulsion responsible is: 1/. insular cortex, for emotion of fear 2/. amygdala, for anger 3/. ventral striatum and basal ganglia, for observation and experience of pain 4/. anterior cingulate cortex and anterior insular cortex, for bodily somatosensory experience 5/. secondary somatosensory cortex in parietal lobe. Presence of such mechanism becomes even more significant when it is taken into account that cerebral neuronal circuits that are responsible for inducing given emotions are located in different brain areas. It turns out that the same insular cortex area that is activated

through exposure to smells perceived by observers as disgusting is also activated by observation of repulsion, disgust expressed by others. It thus turns out that shared reconstruction of disgust takes place in insular cortex and is activated both when disgust is sensed by the actor and when it is observed by another person – an observer. Similar dependency is to be found in case of amygdala which is – as was already stated – activated when the fear is both experienced and observed in others. This fact accounts for shared representation of fear in amygdala both for an actor and an observer. In case of emotion of anger the significant neuronal basis is mostly ventral striatum and basal ganglia. The neuronal mechanism of mirror neurons functioning in the case of pain is more complicated. However, research indicates that anterior cingulate cortex and anterior insular cortex are active both when the pain is experienced and when the experience of pain is observed by other people, especially those who feel love towards the person in pain. Among those observers there are distinct reactions to be found that indicate the avoidance reactions that reflect or suggest the actor's attitude in the form of shudder or flinch with pain when seeing pain experienced by a close person. This indicates the fully empathic reaction of an observer towards an actor. In case of experiencing somatosensory sensations – e.g. touch – both in actor and an observer secondary somatosensory cortex is activated in parietal lobe, adequately to part of the body. Summing up the above data, it can be concluded that there are various systems of cerebral mirror neurons for a number of information fields that can be the subject of experience both for an actor and for an observer (Muthukumaraswany & Johnson, 2007; Fishbane, 2007; Decety, 2007; Jacoboni & Dapretto, 2006; Bucino et al., 2005).

6. Self-cognition – Self-reflection

Recent research indicates that the mirror neuron system also plays a key role in the self-perception or self-cognition process. This accounts for individual's self-concept creation and its impact on shaping interpersonal relationships with close ones or people in general. Similarly to the way that simulation of others' behavior is becoming possible due to existence of mirror neurons, also self-perception – that is perceiving one's own image, own diverse and multi-dimensional self - becomes possible. Therefore we can, in a way, see ourselves in the mirror of our mirror neuron system. This sometimes takes place during moments of deep self-reflection or contemplation-meditation and in consequence of those processes self-regulation becomes possible. Important circumstances when it comes to close interpersonal relationships – like marriage – are those when activation level of mirror neurons, in the above discussed areas, increases significantly when similarity between an actor and an observer exists. This usually takes place between spouses (especially when the level of functioning quality of relationship is high) or in groups, close relatives, friends and acquaintances. Sustaining positive cognition and self-belief can facilitate maintaining good mental condition, health, and enhance psychological immunology system which enables remaining free of negative life events and memories. Moreover, disorder of self-information processing accounts for the basis of many psychological disorders - especially depression – that often impact negatively on interpersonal interactions between partners. This results from, among others, negative functioning of cognitive filter, and specifically, certain neuronal structures. An important role is played here by prefrontal cortex that is responsible for subjective reactions to self and others and more generally to external surrounding reality and thus allows for

effective operating in social environment. To be more specific, the key role is played by medial prefrontal cortex that is responsible for processing of self-information which means cognitive and emotional aspects of self-reflection. However, ventromedial anterior cingulate cortex is also responsible for the emotional sphere. Decrease in metabolism of this cortex and even more so, shrinkage of its capacity remains closely related to depression and other affective disorders and self-evaluation (Cacioppo et al., 2007; Jacoboni, 2007; Jacoboni & Dapretto, 2006; Gotlib et al., 2005).

7. Role of mirror neurons in perception of self and others

Theory of mind conception can be investigated in two significantly different ways. The first one is about cognitive schema of other person's physical being, based on available rather mentalizing observation of that person's behavior. In the second understanding – the one that is taken into account in this work – theory of mind refers to depicting mental states that are based on prediction and interpretation of behaviors of others through taking into account understanding of their different mind states, e.g., their beliefs, biases, attitudes, goals, desires or even images (Saxe & Konwisher 2002; Shamey-Tsoory, 2007, Frith, Frith, 2006).

In said context, mirror neuron systems also account for neuronal basis of theory of mind. According to the simulation theory and even more, the hypothesis of 'mirror-matching' systems that assumes key role of mirror neurons system in discussed here 'mind reading' process, it is assumed that people use their own mental mechanisms to predict or rather reflect, mental processes, emotional states or motor activities in others. Neuronal basis for these abilities is an activity of properly functioning structures of prefrontal cortex that consist of orbitoprefrontal cortex - more in right hemisphere - that is related to or responsible for process of inference about others based on understanding their mental and emotional states. Left hemisphere is more related to tendency to confabulation or rather over-interpretation, using incorrect definitions or divagating from actual state (from the topic). Also the role of medial prefrontal cortex is important; that cortex is responsible for drawing conclusions about mental states or behaviors of others, even those that refer to the past. However, this is only possible when left hemisphere is activated. This process plays significant role in functioning of interpersonal relationships because complex set of mutually related thoughts, feelings and behaviors is an important condition for creating and maintaining closeness in mutually satisfying relationships. It facilitates a few important processes: 1/. getting to know the partner through observing and listening to him/her; 2/. applying correct attribution, assuming or deducting based on mentalization that partner's actions are driven by concern and positive dispositions or intentions; 3/. acceptance, respect and reciprocity since both partners participate in the same process that takes place mutually-bilaterally continuously in time and not only on the conscious level but also subconscious one. It comes as no surprise then that high level of mentalization is a factor that leads to close and highly satisfying interpersonal relationships. Even if small distortions appear, the perception of relationship is related to higher satisfaction; or the inverse is true, but moderating variables are to be found. It turns out that partners in long-term relationships are more precise in reading minds and predicting higher relationship satisfaction than partners in short-term relationships. However, more precise mind reading is to be found among more egocentric individuals because it is related to lower satisfaction

with close relationship and there is lower tendency to positive distortion of perception of its activity forms. According to research, partners in close marital relationships in 50% of times attach importance to precision of mutual evaluations of thoughts and feelings. Other relationships do not attach such great importance. However, the longer the length of marriage the lower the importance attached to precision of reading thoughts and feelings; this is due to the increased mutual trust and relying on one another as well as motivation to follow closely the discussion threads. Those discussions are more of social nature than strategic; the latter one is more characteristic for marital couples with shorter length of marriage. Moreover, there are individual differences in ability to read minds. Individuals with higher social intelligence as well as those with higher education level are more skilled in reading others' thoughts and feelings (Fletcher, 2002; Fletcher et al., 2006; Dindia & Emmers-Sommer, 2006; Jacoboni, 2007; Beer, 2006; Cacioppo, et al., 2007; Saxe & Konwisher 2005).

It needs to be added that hypothesis that applies to ability to read thoughts and feelings, and taking into consideration the mirror neuron system – or to be specific: mirror-matching – seems to be, up to the point, convergent with philosophical- phenomenological approach to intersubjectivity that is defined as shared understanding of happenings between individuals. As it turns out, intersubjectivity can be considered on different levels. On the neuro-psychological level, intersubjectivity between people is generated in every individual through series of mirror matching neuronal circuits. On the phenomenological-experimental level, intersubjectivity creates the feeling of similarity or empathy with others in society. Disorders in such defined intersubjectivity may lead to psychopathological disorders, like schizophrenia, autism, psychotism.

However, it needs to be strongly emphasized that in positive understanding, mirror neurons – or, in other words, neuronal mirror matching – indicate the existence of general feature or ability of human brain to renewed usage of neuronal information processing for similar purposes. This ability is to be found not only at the basis of imitating empathy but also imagination – and so visual, auditory and kinesthetic imagination – and, what is more important, even volitional processes and states. On the other hand though, possibilities related to mirror neurons may also – in the context of social cognition - account for a basis for distortions, using incorrect attributions, heuristics, biases, conflicts etc. Therefore, in the social cognition, it is necessary to use the systems of semantic analysis of social situations, taking into account not only temporal lobes, parietal lobes, temporal-parietal junction but most of all prefrontal cortex of frontal lobes and specifically prefrontal ventromedial cortex responsible mostly for correct processes of control and decision (Lizardo, 2007; Turner 2007; Muthukumaraswamy & Johnson, 2007; Saxe & Konwisher 2002).

8. Cerebral hemispheres' asymmetry

Neurological research conducted for more than 20 years, provides proofs that left and right cerebral hemispheres are specialized in execution of slightly different, but at the same time, mostly complementary tasks and have control over various psychological functions. In particular, researchers concentrate on asymmetry of frontal lobes functioning in both hemispheres. Research indicates that left hemisphere is relatively more active than right

hemisphere when an individual experiences positive emotions, encounters pleasant, joyful events. On the contrary, right frontal lobe is more active when an individual experiences negative emotions and encounters unpleasant events. It needs to be added that this asymmetric tendency, present since early childhood, is stable and coherent in time and needs to be considered in terms of individual differences as a trait. It also indicates its genetic, biological basis. From a practical point of view, an individual that displays activity pattern typical for right frontal hemisphere may have lower threshold of reaction to negative emotions. In other words, said individual is more sensitive and susceptible to have the negative emotions induced when unpleasant events are encountered. Therefore, an even hardly emotionally significant event may induce negative feelings that incline an individual with dominant frontal cortex of right hemisphere to withdraw or avoid. These individuals are more susceptible to experience negative emotions such as breakdown, anxiety, sadness. An individual with activity pattern typical for frontal cortex of left hemisphere has, on the other hand, lower threshold of reaction and experience to positive emotions when pleasant events are encountered. In such an individual, even emotionally weak stimuli may induce and maintain positive, pleasant feelings like happiness, joy, enthusiasm. Those feelings incline such an individual to approach or take appropriate actions. Individuals with dominant right hemisphere are more prone to depression, to react negatively to unknown and new stimuli and situations but very positively to known and familiar stimuli. An opposite susceptibility - i.e. to experience positive emotions – is to be found among individuals with relative domination of left hemisphere frontal cortex. It needs to be clearly emphasized that relative domination of frontal lobe may determine certain action style, behavior or level of experienced content and happiness and most of all, dominant mood. There is no need to justify how significant and of what impact is the relative compatibility of frontal cortex domination of one hemisphere on the level of marital relationship functioning (Larsen & Buss, 2002; Harmon-Jones, 2007; Kalin et al, 2002).

9. Summary

The approach proposed in this paper – based on social neuroscience – does not confine the relevance of analyzing marriage and family functioning in the socio-cultural context but it aims at indicating those aspects that were so far often omitted or considered less important.

Analyses presented above indicate that considering cognitive, emotional and social behaviors of individuals that function in interpersonal relationships, including marriages and families, requires taking neuropsychological approach into account. Today, there is no doubt that structural and functional maturity of many cerebral structures and related to them neuronal circuits, determines functioning efficiency of basic cognitive processes - most of all perception, attention, memory, thinking, imagination - and also various subcortical and cortical structures that are mostly responsible for different emotional states. Newest achievements in modular cerebral functionality allow for explaining the role and significance of various neuropsychological processes and mechanisms that account for the basis of specific behaviors among spouses or family members, such as: self-regulation, empathy, self-cognition, mind reading and mentalization. All those processes account for fundamental basis of cognitive, emotional and social human behaviors and affect perception of self and others and thus nature, specific character and quality of interpersonal relationships that an individual experiences in own marital and family life.

10. References

Atkinson,B.,J., (2006), Emotional Intelligence in Couples Therapy. Advances from Neurobiology and the Science of Intimate Relationsips. New York, London. W.W. Norton & Company.

Beer, J. (2007). The Importance of Emotion-Social Cognition Interactions for Social Functioning: Insights from Orbitofrontal Cortex. In: E. Harmon-Jones, P. Winkielman (Eds). Social Neuroscience, pp. 15-30. New York: The Guilford Press

Beer, J. (2006). Orbitofrontal Cortex and Social Regulation. In; J. Cacioppo, P. Visser, C. Pickett (Eds). Social Neuroscience. People Thinking about People, pp. 153-166.Cambridge, The MIT Press

Beer, J. John, O., Scabini,D. & Knight, R. (2006). Orbitofrontal Cortex and Social Behavior: Integrating Self-monitoring and Emotion-Cognition Interactions. *Journal of Cognitive Neuroscience,*18, 871-879

Buccino, G., Binkofski, F., Fink, G., Fadiga, L., Fogassi, L.,Gallese, V., Seltz.,Zilles, K.,Rizzolatti, G. & Freund, H-J. (2005), Action Observation Activates Premotor and Parietal Areas in a Somatotopic Manner: An fMRI Study. In: J. Cacioppo, G. Berntson (Eds). Social Neuroscience, pp. 133-142. New York: Psychology Press

Cacioppo, J., Amaral, D., Blanchard, J. & et al., (18) (2007). Social Neuroscience. Progress and Implications for Mental Heath. *Perspectives on Psychological Science,* 2, 99-123

Cacioppo, J., & Berntson, G. (2005). Volume Overview: Analyses of the Social Brain through the Lens of Human Brain Imaging In: J. Cacioppo, G. Berntson (Eds). Social Neuroscience, pp. 1-17. New York: Psychology Press

Carr, L., Jaccoboni, M., Dubeau, M-C., Mazziotta, J., & Lenzi, G. (2002). Neural Mechanisms of Empathy in Humans: A Relay from Neural Systems for Imitation to Limbic Areas. In: J. Cacioppo, G. Berntson (Eds).Social Neuroscience, pp. 143-152. New York: Psychology Press

Cattell, R. (1971).Abilities: Their Structure, Growth and Action. Boston: Houghton-Mifflin

Cattell, R. (1963). Theory of fluid and crystallized Intelligence: Critical Experiment. *Journal of Educational Psychology,* 54, 1-22

Cunningham, W., & Johnson, M. (2007). Attitudes and Evaluation: Toward a Component Process Framework. In: E. Harmon-Jones, P. Winkielman (Eds). Social Neuroscience, pp. 227-245. NewYork: The Guilford Press

Decety, J. (2007). A Social Cognitive Neuroscience: Model of Human Empathy. In: E. Harmon-Jones, P. Winkielman (Eds). Social Neuroscience, pp. 246-270. New York: The Guilford Press

Dindia, K., & Emmers-Sommer. (2006). What Partners Do to Maintain Their Close Relationships. In: P. Noller, J. Feeney (eds). Close Relationships. Functions, Forms, and Processes, pp.305-325. New York:Psychology Press

Engelberg, E., & Sjoberg, L. (2005).Emotional Intelligence and Inter-Personal Skills. In: R. Schulze, R. Roberts Eds). Emotional Intelligence. An International Handbook, pp.289-307. Massachusetts: Hogrefe & Huber Publishers

Fishbane, D. (2007).Wired to Connect: Neuroscience, Relationships, and Therapy. *Family Process,* 46, 395-412

Fletcher, G, Simpson, J., & Boyes, A. (2006). Accuracy and Bias in Romantic Relationships: An Evolutionary and Social Psychological Analysis. In: M. Schaller, J. Simpson, &

D. Kenrick (Eds). Evolution and Social Psychology, pp. 189-210. New York: Psychology Press

Fletcher, G. (2002). The New Science of Intimate Relationships. Oxford: Blackwell Publishers Ltd

Goleman. D. (2006). Social Intelligence. The New Science of Human Relationships. New York: A Bantam Book

Gotlib, I., Sivers, H., Gabrieli, J., & Canli,T. (2005). Subgenual Anterior Cingulate Activation to Valenced Emotional Stimuli in major Depression. *NeuroReport,* 16, 1731-1734

Havet-Thomasin, V., Allain, P., Etcharry, F., & Le Gall, D. (2006).What about Theory of Mind after Severe Brain Injury. *Brain Injuty*, 20, 83-91

Herberlein, A., & Adolphs, R. (2007). Neurobiology of Emotion Recognition: Current Evidence for Shred Substrates. In: E. Harmon-Jones, P. Winkielman (Eds). Social Neuroscience, pp. 31-55. New York: The Guilford Press

Ito,T., Willadsen-Jensen, E., & Correll, J. (2007). Social Neuroscience and Social Perception. In: E. Harmon-Jones, P. Winkielman (Eds). Social Neuroscience, pp. 401-421. New York: The Guilford Press

Jacoboni, M. (2007). The Quiet Revolution of Existential Neuroscience. . In: E. Harmon-Jones, P. Winkielman (Eds). Social Neuroscience, pp. 439-453. New York: The Guilford Press

Jacoboni, M., & Dapretto, M. (2006). The Mirror System and the Consequences of its Dysfunction. *Nature Reviews. Neuroscience,* 7, 942-951

Kalin, N., Larson, C., Shelton, S., & Davidson, R. (2002). Asymmetric Frontal Brain Activity, Cortisol, and Behavior Associated with Fearful Temperament I Rhesus Monkeys. In: J. Cacioppo, G. Berntson (Eds). Foundations in Social Neuroscience, pp. 1039-1048. Cambridge: The MIT Press

Larsen, L., & Buss, D. (2002*). Personality Psychology. Domains of Knowledge about Human Nature*. Boston: McGraw-Hill

LeDoux, J. (2000). Emotion Circuits in the Brain. *Annual Reviews of Neuroscience,* 23, 155-184

LeDoux, J. (1995). Emotion: Clues from Brain *Annual Reviews of Psychology,* 46, 209-235

Lieberman, M. (2007). The X and C-Systems: The Neural Basis of Automatic and Controlled Social Cognition. In: E. Harmon-Jones, P. Winkielman (Eds). Social Neuroscience, pp. 290-315. New York: The Guilford Press

Lizardo, O. (2007). "Mirror Neurons", Collective Objects and the Problem of Transmission: Reconsidering Stephen Turner's Critique of Practice Theory. *Journal for the Theory of Social Behaviour*. 37, 319-350

Muthukumaraswamy, S , Johnson B. (2007) A Dual Mechanism Neural Framework for Social Understanding. Philosophcal Psychology. 20.43-63.

Norris, C., & Cacioppo, J. (2007). I know How You Feel: Social and Emotional Information Processing in the Brain. In: E. Harmon-Jones, P. Winkielman (Eds). Social Neuroscience, pp. 84-105. New York: The Guilford Press

Ochsner, K. (2007). How Thinking Controls Feeling: A Social Cognitive Neuroscience Approach. In: E. Harmon-Jones, P. Winkielman (Eds). Social Neuroscience, pp. 106-133. New York: The Guilford Press

Ochsner, K., Bunge, S., Gross, J., & Gabrieli, J. (2002). Rethinking Feelings: An fMRI Study on the Cognitive Regulation of Emotion. In: J. Cacioppo, G. Berntson (Eds). Social Neuroscience, pp. 133-142. New York: Psychology Press

Rostowski J. (2008), The Neuropsychological Basis of Social Inteligence . *Polish Journal of Social Science. 3 , 59-80.*

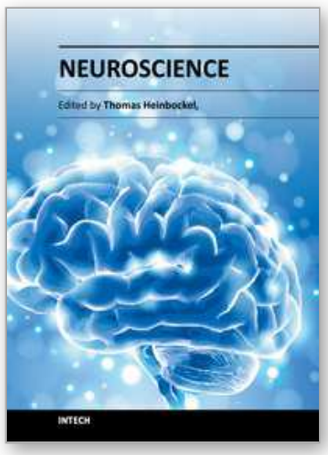
Rostowski J., (2007), The Selected Aspects of the Memory in a Neuropsychological Perspective. *Polish Journal of Social Science.* 2,. 63-98.

Saxe, R., & Kanwisher, N. (2002). People Thinking about Thinking People: The Role of the Temporo-Parietal Junction in "Theory of Mind". In: J. Cacioppo, G. Berntson (Eds). Social Neuroscience, pp. 171-182. New York: Psychology Press

Shamay-Tsoory, S. (2007). Impairent Empathy following Ventromedial Prefrontal Brain Damage. In: T. Farrow, P. Woodruff (Eds). Empathy in Mental Illness, p. 89-110. New York: Cambridge University Press.

Sundie, J., Cialdini, R., Griskevicius, V., & Kendrick, D. (2006). Evolutionary Social Influence. In: M. Schaller, J. Simpson, & D. Kenrick (Eds). Evolution and Social Psychology, pp. 287-316. New York: Psychology Press

Turner, S. (2007). Mirror Neurons and Practices: A Response to Lizardo. *Journal for the Theory of Social Behaviour*, 37, 351- 371



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If one asks what neuroscience is, the answer can be found in this book. Neuroscience embraces not only anatomical and physiological studies but also cell biology, computer science, and biochemistry. Equally important for neuroscientific research are other disciplines, such as psychology, psychiatry, neurology and additional recent ones, such as neuroeconomics and social neuroscience. This book comprises chapters on diverse topics in neuroscience ranging from cellular, computational, cognitive, and clinical neuroscience. Individual chapters focus on recent advances in specific areas including social neuroscience, which is a relatively new field that studies the neural basis of social interactions. Other chapters focus on technological developments such as optical tools to study the function of the brain. All chapters represent recent contributions to the rapidly developing field of neuroscience and illustrate the range of research conducted under the umbrella of the truly interdisciplinary neurosciences.

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