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Review article ■

Neurobiology of Psychotherapeutic Relationship- New Perspectives

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SUMMARY

Since the time of Freud's "Project for psychology as natural science" in 1895, at the dawn of psychoanalysis as the theory and therapy, psychoanalysis and psychotherapy in general have been attempting to establish and develop their biological roots. Numerous external and internal limitations and resistances have been limiting and opposing this process for almost a century. The last two decades brought a significant change in this view, especially following the development of contemporary neuroimaging techniques with their dynamic and functional features and growing interest for mental processes on behalf of neuroscience.

The aim of this paper was to review scientific articles on recent advances in the field of neurobiology of psychotherapy, especially neurobiological underpinnings of psychotherapeutic relationship, and point to the new perspectives this knowledge brings.

Recent advances in neurobiology and psychotherapy research open the way for the integration of psychotherapy and neurobiology. With this regard, science could contribute to closing the mind-brain gap which has been artificially dividing a human being for centuries. An integrated field enables new scientific perspective for both disciplines with multilayered understanding of mind-brain functioning.

Key words: neurobiology, psychotherapy, relationship

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INTRODUCTION

In his 1895 "Project for a Scientific Psychology" (1), Freud attempted to construct a model of the human mind in terms of its underlying neurobiological mechanisms. It was an endeavour of his scientific spirit "to furnish a psychology which shall be a natural science". At that time, it was only an ideal that could not possibly be achieved. In spite of his great disappointment, Freud wrote to his colleague and friend Fliess that „at some future date we shall have to find a contact point with biology." His „Project" became theoretical foundation of psychoanalysis, a new psychotherapeutic approach to mental disorders. However, the striving of psychoanalysis and psychotherapy to connect with their neurobiological „roots" stayed inherent to their being. Last decades brought new possibilities for the achievement of this, previously, quite a distant goal.

Psychotherapy research

Since the very beginning of the implementation of contemporary psychotherapy in the treatment of mental disorders, it has been an empirically based approach. Nonetheless, from the current scientific perspective of medical science, valid empirical evidences of its applicability and efficacy were lacking for many decades, because of many rational as well as irrational reasons.

For many years, the leading attitude of the majority of psychoanalytic community was repulsive toward any kind of research. Explanation was in the special nature of patient-analyst relationship, which could not accept and stand external interferences in the form of necessary research methodology. On the other hand, the existing research methodology (controlled clinical trial or clinical research trial methodology) could not fit psychoanalysis or any other psychological therapy. Psychoanalysis used case reports as the only acceptable and understandable method of research and review of psychotherapeutic process.

Changes in this area were very slow, but the current view gives us a very different picture - there is a growing body of research with many significant scientific evidences, especially for psychoanalytic psychotherapy efficacy and effectiveness. Psychotherapy research using qualitative and quantitative methodology and longitudinal design for assessing outcome of psychotherapeutic process has proven that there are significant and favourable psychological changes deriving from successful psychotherapy (2-4).

At the same time, following these discoveries, there appeared a growing interest in the research of the mechanism of action of successful psychotherapies. In the other words, the main question of the investigations became - which changes or which factors bring one psychotherapy to a successful outcome?

This area of research has brought very interesting results. Quite contrary to the expectancies, psychotherapeutic relationship (and not psychotherapeutic technique) has been derived as the main healing factor in psychotherapy. Decades of research indicate that the provision of therapy is an interpersonal process in which a main curative component is the nature of the therapeutic relationship (5).

Recent advances in neurobiology

Revolutionary changes in the research of brain functioning happened during the last decade of the 20th century (called "decade of brain"). One of them appeared due to enormous technological progress, which enabled scientists to observe brain functioning in the real time, using the methods of functional neuroimaging (functional magnetic resonance imaging, single photon emission tomography, positron emission tomography). Brain was not perceived as only static picture anymore. There also appeared a new, dynamic perspective of neuroimaging research. Application of many functional tests came to the fore, giving new possibilities for observing mental phenomena during their dynamic performance. Some of those tests enabled better understanding of pathological states because they could imitate them.

The most revolutionary discovery in the last decade of the 20th century certainly was the discovery of brain plasticity or neuroplasticity. During most of the 20th century, the consensus among neuroscientists was that brain structure is relatively immutable after a critical period during early childhood. This belief has been challenged by findings revealing that many aspects of the brain remain plastic even into adulthood. Upon discovery of the growth of new neural tissue, or neurogenesis, in the adult human hippocampus, the brain region responsible for memory (6), the dogma of the "hardwired brain" was formally repudiated.

In addition, a new, 21st century genetic studies, have discovered that DNA code of the human genome does not determine protein synthesis in a one-to-one fashion; instead, genes are subject to epigenetic processes (i.e. modifications that do not occur due to changes in the basic genetic sequence of amino acids but instead result from biological and environmental influences on the expression of genes as proteins) (7).

These new advances in neurobiology have paid attention of researchers in this discipline to environmental influences, and broadened previously dominant neurobiological view that everything in human experience and mental life is predetermined by genetics and reduced to neurochemical processes.

Rapprochement of psychotherapy and neurobiology

Longstanding efforts of many scientists from different fields have resulted in gradual rapprochement between psychotherapy and neurobiology. Psychotherapy research has begun to include neuroimaging techniques in its studies on psychotherapy process and outcome as the new way to confirm its efficacy at the level of brain function and structure. It has resulted in numerous studies which have found functional and structural brain changes after the process of successful psychotherapy, across different mental disorders (8-10). Neurobiological studies have turned their attention to environmental influences and individual and interpersonal experiences which shape brain structure mediated through gene expression and consequent neuroplastic effects. Psychotherapy in itself is a very important new experience for an individual, and its effects have the same neurobiological underpinnings.

NEUROBIOLOGY OF PSYCHOTHERAPEUTIC RELATIONSHIP

Empathic understanding, transference - counter transference space of intersubjectivity and working alliance are the main components of psychotherapeutic relationship.

„A path leads from identification by way of imitation to empathy, that is, to the comprehension of the mechanism by means of which we are enabled to take up any attitude at all towards another mental life“.

Sigmund Freud, 1921 (11)

„It is only by empathy that we know the existence of psychic life other than our own“ .

Sigmund Freud, 1926 (12)

One of the most important discoveries in neuroscience during last two decades certainly is the discovery of the mirror neuron system. Eminent neurobiologist Ramachandran (13) stressed that „mirror neurons will do for psychology what DNA did for biology: They will provide a unifying framework and help explain a host of mental abilities that have hitherto remained mysterious and inaccessible to experiments“. Mirror neuron system is a neurobiological underpinning for the process of empathic understanding.

The theoretical literature defines empathy as the ability to both cognitively and affectively understand and respond to the unique emotional experience of another person, which entails a degree of sharing that person's emotional state and includes taking the perspective of the other person (14). Experimental psychologists refer to three necessary qualities ascribed to empathy: 1. *knowing* what another person is feeling (empathic accuracy); 2. *feeling* what another person is feeling; and 3. *responding compassionately* to another person's di-

stress (15). A critical review also found that lack of therapist empathy was the best predictor for negative outcomes in psychotherapy (16).

In a very short interval of time, two research groups (Rizzolatti et al, 1996; Gallese and Goldman, 1998) (17,18) have come to this important discovery, in the population of macaque monkeys. The monkey in the experiment was wearing microelectrode that could register the activation of single neurons in premotor cortex. During performance of simple act of taking food and putting it in the mouth, neurons in premotor cortex were being activated - it was the expected finding. However, unexpectedly and accidentally, the activation of the same neurons was registered when the monkey was sitting still and just watching experimenter performing the same action. Thus, observing the act of taking food activated the same neurons as during real performing the action. Similar neurons have been discovered in the parietal cortex, and named parietal mirror neurons (19). This discovery was just initial in a series of research in this area. It was not possible to register single neuron activation in humans, but the functional neuroimaging had the key role in research of humans. Different studies gave convincing evidences that in the human brain also exists the mirror neuron system in premotor and parietal areas, activated during perception and performing action (19-21). There has also been research about emotions. Wicker et al. in 2003 (22) showed that experience of the feeling of disgust and observing of this feeling facially expressed by the other person activate the same structure - anterior insula in observer as if actually self-experiencing this feeling. The similar have been found for painful sensations. Singer and Frith (23) expressed the view that the unique mental attitude of the individual could be the key variable for the degree and quality of activation of neuron circles during experiencing sensations of the other persons.

Why are these discoveries so important? Neuroscientists suggest that these kinds of facts discover important data about the biology of higher mental functions. Psychotherapists consider them very important for the insight in interpersonal communication - these discoveries in fact explain interpenetration of subjective beings in personal contact - this is very important for the therapy process, because therapeutic relationship is the most powerful healing factor in every kind of psychotherapy.

Gallese (24-26) developed his theory of embodied simulation, based on these neurobiological discoveries. The theory explains empathic understanding of two subjects from the point of the implicit functional brain mechanism. When we see the facial expression of one person, and this perception leads us toward experiencing this expression as specific affective state, we do not achieve this understanding thanks to the analogy, but the other's feeling is created in us, experienced and in this way directly understood, thanks to the embodied

simulation-shared body state. Activation of the neural mechanism shared by the observer and the observed person enables experiential understanding. Embodied simulation is, according to this author, fundamental for automatic, unconscious and immediate understanding of actions, intentions, emotions, sensations, maybe even a linguistic expression. When we confront with behaviour of the other person, embodied simulation creates specific experience of „intentional attunement“ which is the base for the close interpersonal relationships.

Embodied simulation theory, derived from the discovery of the mirror neuron system in humans, could

explain the processes of empathic understanding and identification in psychotherapy and other close relationships. Embodied simulation is not just the imitation, because activation of neuron circles does not lead to performing action. There must be an inhibitory mechanism, which prevents the conversion of these impulses into actions.

Empathic understanding has its individual variations. Psychopathological extreme is the absence of empathic understanding in autism (Figure 1).

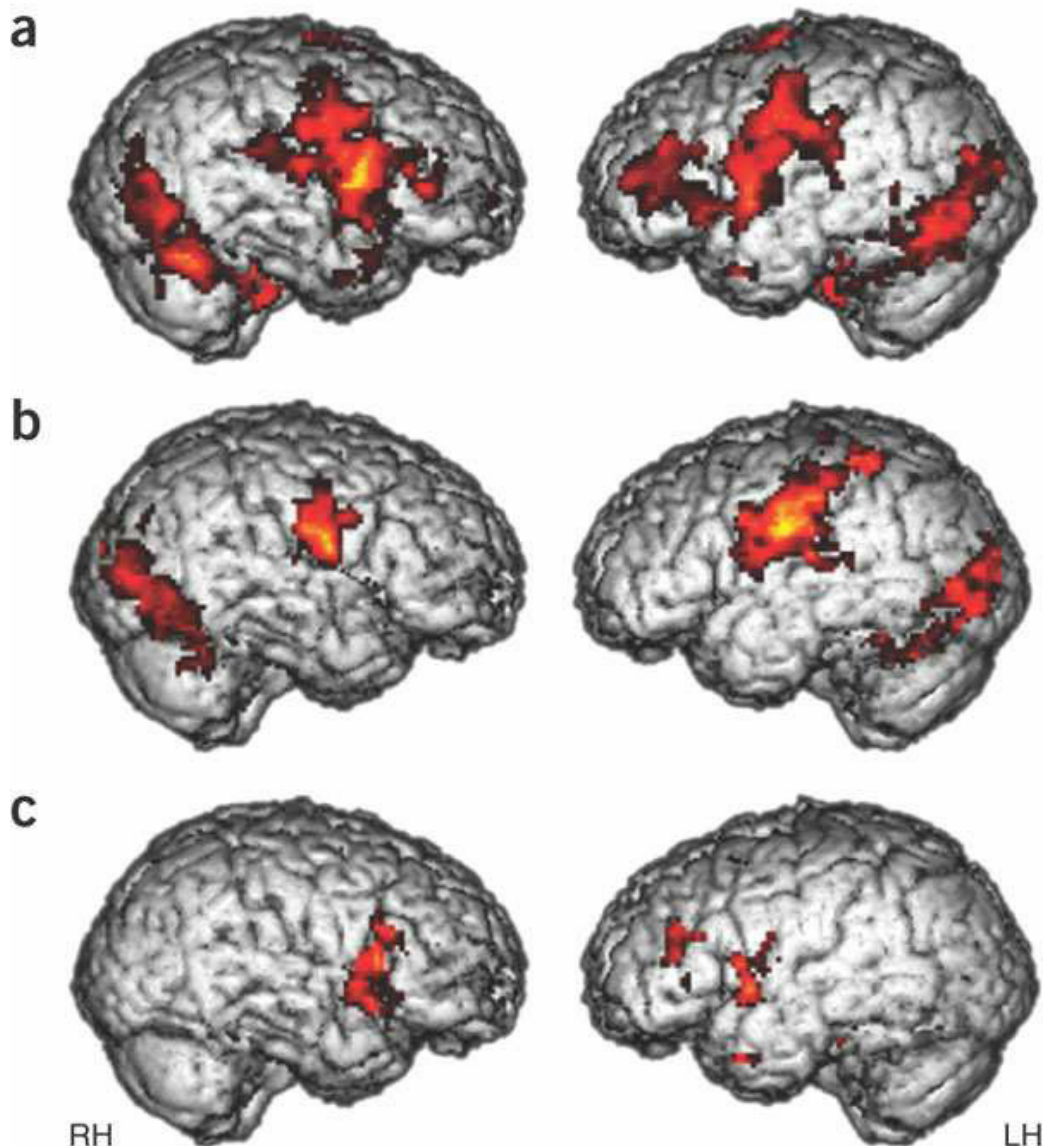


Figure 1. fMRI images of mirror neuron areas
a-control group,
b-autistic spectrum disorders group,
c-areas where the activation differences was significantly greater in control group - pars opercularis

Recent research suggests that, when the autistic persons observe some actions of the others, it does not activate mirror neuron mechanism in their brain. There is the basic deficit at the level of the embodied simulation and mirror neuron system (26). Dapretto et al. (27), in their fMRI study, concluded that dysfunctional mirror neuron system is at the basis of social deficits observed in autism.

This knowledge enables better understanding of the mechanism of projective identification which is very important in patients with lower integrated personalities. Existence of mirror neurons explains automatic „replication“ of projected feelings (from patient to therapist), because those feelings are observed thanks to many verbal and nonverbal signs, and then appear in therapist by the way of activation of the mirror neuron system (28). Feelings could be amplified because of the unconscious interpersonal pressure from the patient expressed in unconscious behaviours (29). Further processing of these emotions in therapist could be different - they could stay unrecognized and result in counter transference reactions, but the aim of the therapist is to become aware and understand them, and then return them to the patient in „metabolized“ form, enabling patient to reintroject and accept them.

Theory of embodied simulation is also important for the theory of therapeutic action of psychoanalysis and psychotherapy. Circular and reciprocal processes of embodied simulations in patient and therapist, therapist's ability for metabolizing of patient's affects (30), make close therapeutic relationship and the feelings of connectedness. According to Fonagy (31), a patient experiences himself safe in therapist's psyche, it enables him to reach a self-discovery, and even more important, discovery of self in the mind of the other. Therapist uses intuition and empathy to become psycho-biologically attuned with patient's affective states and their changes, making thus context in which he could function as the regulator of patient's neurophysiology.

Another very important and therapeutically powerful aspect of psychotherapeutic relationship is working alliance, defined as quality and strength of cooperative relationship between patient and therapist in psychotherapy, and consisting of goal, task and bond components (32). Studies investigating the influence of different psychotherapies on brain structures and functioning, found the common causative factor which helps establishing functional connectedness between prefrontal cortex, hippocampus and amygdale. This

“common factor” could be a bond component of the working alliance or “good rapport” between members of therapeutic dyad. It has a calming effect because of the release of oxytocin, neurohormon which causes feelings of warmth, intimidation and personal connectedness with others (33), as well as reduced sensitivity of amygdale to external threat (34). These effects were also registered in individuals with the experience of parental care (35).

One of the functions connected with good working alliance in psychotherapy is a reflexive function - the ability to reflect upon self and other's emotional states. Insufficiency of this function is one of the neurobiological findings in borderline personality disordered patients (BPD). A research using specific neuropsychological tests designed to register structural brain changes has shown an improvement in reflexive functioning of BPD patients after transference focused psychoanalytic psychotherapy (36). Results of neuroimaging studies have shown an improvement in capacity for empathy and reflexive function. These improvements were connected with a change in metabolic activity of right orbito-frontal cortex and its subcortical connections (37, 38).

CONCLUSION

Over the past two decades, two fields of empirical investigation, neurobiology and psychotherapy, have offered important findings that may lead to a paradigm shift in our conceptions of psyche and soma and the modes of their interrelationships. These two fields mutually inform one another, depicting interpenetrating biopsychosocial relationships on different scales: neuroplasticity research describes how neurons within the brain proliferate and grow new connections across the lifespan, whereas psychosocial genomics describes the processes by which psychological and social experiences activate or deactivate genes, thereby driving the development of new neural pathways. Psychotherapy becomes biologically informed. The interplay of these sciences reflects a vision of humans as inherently resilient; psychosocial factors appear to stimulate gene expression within neurons resulting in alterations to the structure and function of the brain. Psychotherapy enables reversal of this process, when they become pathological. Discoveries from both fields reveal that experience and learning can contribute to positive change, even at the neurobiological and structural levels.

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NEUROBIOLOGIJA PSIHOTERAPIJSKOG ODNOSA - NOVE PERSPEKTIVE

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Sažetak

Još od vremena Frojdovog „Projekta za psihologiju kao prirodnu nauku“ iz 1895. godine, u začetku psihoanalize kao teorije i terapije, psihoanaliza i psihoterapija uopšte, nastojale su da uspostave i razviju svoje naučne korene. Brojna spoljašnja i unutrašnja ograničenja i otpori suprotstavljali su se ovom procesu gotovo čitav jedan vek. Poslednje dve decenije donele su značajnu promenu, posebno zahvaljujući razvoju savremenih tehnika neuroimidžinga sa dinamičkim i funkcionalnim svojstvima na jednoj i rastućem interesovanju neuronauka za mentalne procese na drugoj strani.

Cilj našeg rada bio je da prikazemo pregled naučnih članaka koji se bave novim dostignućima u oblasti neurobiologije psihoterapije, posebno neurobiološke osnove psihoterapijskog odnosa i da ukažemo na nove perspektive koje ovo znanje može da donese.

Nedavna dostignuća neurobiologije otvaraju put za integraciju psihoterapije i neurobiologije. U tom smislu, nauka može doprineti zatvaranju jaza duša-mozak, koji je veštački delio predstave o ljudskom biću i njegovom funkcionisanju skoro čitav vek. Integrativno polje omogućava novu naučnu perspektivu za obe discipline, sa slojevitim razumevanjem funkcionisanja jedinstva duša-mozak.

Ključne reči: neurobiologija, psihoterapija, odnos