

Psychoanalysis within the Neurobiological Context: A Brief Review of the Neuroscientific Literature

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ABSTRACT

Objective: The simple fact that psychoanalysis and neuroscience have been developing separately over time is, in large part, due to the complex mind-body relationship, thus resulting in a split of the study objectives and different methods of investigation. The interfaces between such methods aiming for possible integration are emphasised in the present review.

Method: MEDLINE and LILACS databases were used for searching relevant information.

Results: The emergence of psychoanalysis promoted a revolution in the comprehension of the mental life by developing an insight into the unconscious process. Several researchers believe that psychotherapy may be a learning method for acquiring new implicit memories by modifying the neuronal connections lastingly. On the other hand, such hypotheses are hardly proved as a few scientific methods exist for testing them.

Conclusion: The psychoanalytic method has been shown to be fruitful in producing scientific hypotheses, but at the same time it is not efficient for testing them. This is readily observed when the number of articles on psychopharmacology and biological psychiatry are compared to the number of psychotherapy studies published in the literature, which are extremely rare and reflects consequently the organic tendency in psychiatry.

Key-words: Psychoanalysis; Neuroscience.

INTRODUCTION

It is difficult to think about the mind-body complex as two distinctive areas of investigation when the study purposes of both psychoanalysis and neuroscience are somehow intrinsically linked to each other. However, psychoanalysis have virtually developed independently of neuroscience, which created a gap between the different investigation approaches. In 1890, Sigmund Freud¹ was the first one to investigate and explore such a relationship,

delineating a possible integration known as *Project for a Scientific Psychology*, which was published following his death in 1939. In his project, Freud tried to translate the knowledge of the mind into the languages of neurophysiology and anatomy by using instruments based on speculations. As the gap between what was known about mind and the physiologic and anatomic methods was far wider during that time, Freud had no other choice but to quit his project. Despite the exponential and rapid increase in the neuroscientific knowledge, those who

those who attempt to correlate psychoanalysis with neuroscience have committed the same mistakes made by Freud 100 years ago, that is, the failure in developing a valid method for correlating the psychoanalytic clinical findings with the type of neuroscientific knowledge.

Freud^{1,2} worked with the physiologist Ernst Brück and the neuroanatomist and psychiatrist Theodor Mynert in their laboratories, besides serving as a neurologist at a general hospital in Vienna. Before establishing the psychoanalysis, Freud had written monographs about infantile cerebral palsy and aphasia. Freud had initially been trained in neurology as a follower of the “Austrian School”, where the neurological symptoms were classified as a syndrome according to its corresponding lesion. On the other hand, Charcot and the French School had also influenced Freud, who supported the idea that the most important aspect within the neurology was not to explain the clinical phenomena based on a corresponding lesion, but simply identify them, classify them, and describe them. The descriptive analysis was used by Freud in his many contributions to the neurobiology, firstly in his studies of aphasia, then of cerebral palsy, and lastly of neuroses. He rejected the clinical-anatomical method for localising mental functions, believing that it could only be used for more elementary functions such as vision, hearing, and taste. According to Freud, therefore, the neurological organisation of the mental faculties would not be easily localised because they adapt to the various circumstances of life and are also based on their own inner structures, which are subjected to constant changes during the developmental process.

After the *Project for a Scientific Psychology*^{1,2}, Freud experienced a new phase of orientation in combination with identity changes, then becoming a clinical neurologist, and lastly psychologist and psychoanalyst. The psychophysiology issues were gradually losing their urgency. However, the scientific concepts in which Freud believed during his research activities still permeated his theoretical universe and served as both

fundamental supposition and metaphoric incursion into the metapsychology, whose intention was to provide a stable theoretical basis to psychoanalysis. Thus, metapsychology was a movement towards this so-called “beyond psychology”, in which psychology meets its essentials and meaning. To Freud^{1,2,3} however, this meant that the biological and neurological bases of the psyche should be deduced by clinical observations and systematised by theoretical elaboration, even though they could not be directly or experimentally established during that time. One might say, therefore, that the Freudian metapsychology is a kind of “fancy neurology” or, at the best, a speculative neuropsychology which still needs to be empirically verified, as Freud had continuously stated.

During the first half of the twentieth century, psychoanalysis revolutionised the comprehension of the mental life by developing the insight into the unconscious mental process, the psychic determinism, the infantile sexuality, and the irrationality of the human motivation as well. In contrast, during the second half of the twentieth century there seemed to be no relevant continuity regarding such advances⁴. One of the most important factors contributing to this lack of continuity was the non-involvement of psychoanalysis in scientific procedures, more specifically, overlooking the development of methods for testing its own hypotheses^{3,4}. Therefore, psychoanalysis entered the twenty-first century with its credibility at stake. And such an isolation compromised the evolution of the psychoanalysis as a whole. The Freud’s visionary conception – that biochemistry would play a key role in understanding the mental phenomena – was also expressed in one of his last works: *Analysis Terminable and Interminable*¹. Psychoanalysis has not associated with the scientific research as other disciplines have done so. In fact, psychoanalysis had betrayed its revolutionary and impacting origins by assuming a conservative approach in the clinical practice. This isolation is deplorable because psychoanalysis still represents a more coherent and intellectual view of the mind. In

order to rescue its intellectual power as well as its influence, it is necessary to promote not only critical encouragement, but also an involvement of the psychoanalysis in the sophisticated and realistic theory of human motivation by developing a closer relationship with neuroscience^{4,5}. Such a relationship can represent two important aspects for psychoanalysis: one conceptual and other experimental. Regarding the conceptual aspect, neuroscience can represent a new basis for the future growth of the psychoanalysis, thus being more suitable than metapsychology. Regarding the experimental aspect, the biological insights can encourage both research and specific approaches for testing the mind functioning^{2,6}. At the beginning of the twentieth century, psychoanalysis had introduced a new method of psychological investigation based on a free-interpretative association, and for many years not only Freud, but also other psychoanalysts reported that psychoanalytic sessions provided the best context for the scientific analysis^{4,7}. Therefore, psychoanalysis contributed to the understanding of the mind by just hearing the patient and testing suppositions of the analytical situation.

The psychoanalytic comprehension of what would be a symptom was originally linked to the medical model, that is, there would be an imbalance within the body resulting from something strange⁷. According to the Freudian¹ thinking, the symptom carried inadequate and replacing sexual satisfaction, a libidinal fixation occurring in the early developmental phases which would be expressed into role playing and repetition of stereotyped behaviours. Freud¹ believed that genitality expressed the male maturity as it represented a separation from the self-eroticism and also the beginning of impulses towards the external object. Consequently, the male libidinal investments were evaluated according to the expectancy models regarding moral and sexual behaviours, and any divergence from what was thought to be expected would mean disturbance and pathology^{1,2}. During his whole work, Freud¹ addressed the idea of conflict and

opposition forces by focusing on sexual drives, self-preservation, and repression, whose mental functioning was hypothetically conceived as a physical model of opposite forces. Repression¹, the cornerstone of the Freudian theory, results from a conflict between impulsive force, which impels the access to consciousness, and counter-force, which is mobilised by the censure in order to impede such an action. The symptom would be the result of repressing an incompatible idea in relation to the awareness by transferring the corresponding affect to another resembling idea, thus establishing a false association. The presence of a symptom, therefore, would indicate a failure in this repressive process. The emergence of a symptom would involve conflictive forces resulting from a particular solution adopted by the ego so that both interests could be simultaneously attended: on the one hand, the ego acts to keep the repression by preventing undesired contents from reaching the consciousness, thus alleviating the superego demands; on the other hand, the ego allows an impulsive satisfaction to be replaced by forming a symptom. Freud believed, based on such a conception, that unveiling hidden ideas through the symptom would result in its remission, and then, the meaning of the symptom had become his research orientation. He stated that both free-associative method and interpretation of the transference would enable the repressed material to be accessed. Nevertheless, Freud was faced with difficulties regarding the clinical practice: he had realised that deciphering the patient's thoughts was not enough, since something still remained untouchable, inert, and unshaken^{1,4,8}.

After the World War II, the split between neurology and psychiatry had become explicitly known. The American Archives of Neurology and Psychiatry were also separated into two distinctive journals as well as their training programs: organic disorders and functional disorders^{9,10}. Since the 1960s, both comprehension of neuropharmacology and identification of neurotransmitters have indicated the biological trend in psychiatry. At first, the biological psychiatry was concerned with

studying the neurotransmitters in the brain and cerebrospinal fluid, but modifications in the receptors associated with mental illnesses and neuroimages were also identified^{7,9}. The mind-brain relationship is poorly understood in detail, mainly how brain interacts with several mental processes. The great challenge for both neuroscience and psychiatry is to delineate how this relationship may be satisfactory for neuroscientists studying the brain and psychiatrists studying the mind^{10,11}.

According to Gelb¹⁰, one can observe a decrease in the number of psychotherapy titles published by the *American Journal of Psychiatry* between 1950 and 1986/87 as well as by the *Archives of General Psychiatry* between 1960 and 1986/87. For example, in 1987, no article on psychotherapy had been published by the *American Journal of Psychiatry* and only three ones had been published by the *Psychosomatics* (1989). This tendency has become more evident as the mental illness is increasingly viewed as a biochemical disorder, which brings the psychiatric practice near to psychopharmacology and biological psychiatry^{10,14}. Such a justification, on the one hand, is based on biochemical alterations occurring, for example, in the cases of depression. On the other hand, the advances in the studies of neurotransmitters have somehow made psychiatry “inhumane”. Likewise, these changes taking place in the body at medium and long terms have been measured by techniques such as positron emission tomography (PET), quantitative EEG, biofeedback, evoked cerebral potential, and other neuroimage resources, but the question to be raised is what has induced these biological changes¹⁵.

The study of mental phenomena is the target of psychoanalysis and neuroscience, which have been in diametrically contrary positions during the twentieth century. This divergence had occurred, in part, due to the pronounced split between brain (biological) and mind (psychological), which was a conception thought to be true^{5,7}. According to Kandel¹⁶ neurology can importantly contribute to eight areas of psychoanalysis, namely: 1) the nature

of unconsciousness, 2) the nature of psychological causes; 3) psychopathology; 4) early experiences; 5) preconsciousness, unconsciousness and prefrontal cortex, 6) sexual orientation, 7) psychotherapy and structural changes in the brain; 8) psychopharmacology as an adjunct to psychoanalysis. The twenty-first century has been defined by some scientists as the “century of the mind”. Within this context, the narrowing of the gap between psychoanalysis and neuroscience has become crucial: psychoanalysis, with its vast experience in subjective emotional and affective issues, can serve as a guide for neurobiological interventions. On the other hand, neuroscience can objectively validate and even correct the psychoanalytic theories by using experimental methods of investigation and providing more scientific rigour as well⁸.

Nevertheless, the analyst can also make use of a range of theories according to his familiarity with them, and this determines how the analyst will shape the patient. As there is no other way of testing the different theories of psychoanalytic process, they are likely to coexist under several forms and the patients will somehow be educated consciously or unconsciously by different ways. Perhaps such a coexistence of theories may cause some psychoanalysts to reject the idea of giving scientific credibility to the psychoanalysis, for they consider it a discipline based on the philosophy of life^{9,12,17}.

METHODOLOGY

The present article was carried out by performing a literature search in the LILACS and MEDLINE databases as well as by directly consulting books and periodicals on health mental. The keywords *psychoanalysis* and *neuroscience* were used. A review of more than 60 titles yielded 47 articles which were directly related to the topic and objectives of the present article.

OBJECTIVES

The article aimed at briefly describing some neuroscientific discoveries regarding the brain

functioning and how these findings have somehow related to the psychoanalytic theories. The reasons on why the psychoanalysis theories have difficulties in adjusting to the models of scientific research were addressed and the possible integration of psychoanalysis and neuroscience in order to understand the complex brain-mind functioning was discussed as well.

1) NEUROSCIENTIFIC DISCOVERIES & THE PSYCHOANALYTIC THEORIES

Neurology of Memory and Learning

Freud¹ emphasised that what cannot be remembered by the patient will be repeated during his or her relationship with the analyst. As a result, the patient's way of relating to the analyst will yield much information on his or her unconscious conflicts and inner object relations. In 1954, Milner¹⁸ made important discoveries on memory by studying amnesic patients and he noted that the medial temporal lobe and the hippocampus were accounted for the conscious reminiscence of persons, objects, and places, what is commonly known as declarative or explicit memory. Later, in 1957, Milner¹⁸ also described the unconscious memory, known as implicit or procedural memory, which is only evidenced by the patient's behaviour instead of his or her memories. The explicit memory, which is located in the cortex and hippocampus, involves a conscious process which can be evoked. The implicit memory, which is situated in the subcortical regions, can be divided into three forms: 1) the preparatory memory, which registers the shape of the objects and sounds, 2) the procedural memory, which accounts for the skills and habits, and 3) the affective memory, which is located in the amygdala and accounts for the emotional responses by means of a classic conditioning. The early attachment relations, which characterise the first two years of life, are the first ones to be internalised, retained, and codified as procedural memory and

are commonly known as transference. What is unfolded in relation to the therapist is the usual, automatic, and stereotyped way by which the patient relates to the objects shaped by his or her attachment relations during the first years of life. These relationship configurations are implicitly codified by the procedural memory because they are out of the conscious awareness.

According to Kandel^{16,17}, there is evidence showing that environmental events can change reversibly and irreversibly both structures and functions of the brain. He demonstrated that the process of memory formation is associated with structural and functional alterations in the neurones at biochemical level, particularly during the pre-synaptic facilitation as a result of environmental changes. Reiser⁵ has suggested that the psychoanalytic process of free-association can be conceptualised as the way by which the analyst has access to the network of interconnected memory in order to change synaptic connections, unmake environmentally influenced connections during childhood, for example, and add new connections whose synapses were not enough to achieve a more adjustable learning. Therefore, one can say that neurotic disorders are produced by the child-environment interaction, thus causing erroneous synapses, errors involving gene activation, abnormal calcium-channel activity, and lack of enzymes. Such biological alterations are viewed as maladaptive patterns of thoughts, feelings, and interactions. The psychotherapist's task is to revert all these errors by providing an environment suitable for allowing neuronal interaction.

Introjection of a new object relationship occurs during the psychotherapy treatment, and this should be enough to modify the primitive patterns of connections through the regressive process of transference. As these relations occur on the affective plane, their mnemonic registration also involves the implicit memory, that is, they happen unconsciously¹⁹.

2) THE NEUROBIOLOGY OF DREAMS

The cornerstone in the neurobiology of dreams was based on the discovery that human beings present slow EEG waves (slow wave sleep, SWS) during long sleep periods without dreams followed by brief dream episodes, which is characterised by fast cortical EEG activity and involuntary eye movements (rapid eye movement - REM sleep)²⁰. The neurophysiological basis for understanding dream and wake remains unclear. The elements of REM sleep are generated inside the brain stem, whereas the non-REM sleep is partially controlled by cerebral regions located in the prosencephalus, thalamus, and hippocampus. So far no specific “sleep centre” was identified in neuroanatomic terms^{20,21}.

According to Wilson¹⁴, the dreams seem to play an adaptative role in acquiring new memories and this is shown by the hippocampal processing of the daily perceptions of the new memories, whose synapses are not sufficiently strong in comparison to those of the memories previously stored. Such a procedure could either reinforce or change behavioural strategies aimed at increasing or decreasing the interneuronal connections, thus facilitating or altering the synaptic connections. These preliminary findings support, in part, the Freud's theory on dreams, which would function as a window for those memories not available to conscience.

Mark Solms²⁰ studied the dreams of 332 patients with different types of neurological and neurosurgical lesions during four years and he compared them to a control group so that he could analyse the cerebral structures and their corresponding functions involved in the dream process. By using tomography images, magnetic nuclear resonance, cerebral angiography, and surgical and biopsy observations, Solms evaluated the respective compromised cerebral areas by grouping them according to both compromised area and pathology as well as by correlating any change to dream patterns. Solms reports that dreams are not

influenced during the wake period, thus corroborating the classic Freudian theory. Dreams originate in the mediobasal, frontal, and anterior regions of the limbic systems, which are distant from the dorsolateral and parieto-occipital regions accounting for, respectively, wake and mnemonic perception. To Solms, the dream represents action scenes of the retrospective factors of the individual's mental life.

According to Ribeiro²¹, the enormous contribution regarding the Freud's and Jung's concept of dream was greatly ignored by Science as no quantitative method were available, but recent experimental results have corroborated the important psychoanalytic insights, suggesting that dreams can play a crucial role in consolidating memories by causing the newly acquired memories to migrate to hippocampus and neocortex.

3) THE NEUROBIOLOGY OF ANXIETY AND DEPRESSION

Freud¹ described the symptom as a substitutive sign of instinctive dissatisfaction which remains in latent state, that is, the process of repression takes place when superego demands that ego associate with an instinctive cathexis provoked by ID, and what would satisfy the drives becomes now disgusting.

Freud¹ reported on the phenomenon of *la belle indifference*, traditionally associated with conversion disorder, as being a way by which the hysterical patients present themselves somewhat alienated and deprived of emotional feelings about their complaints. One can observe that the reminiscences and symptoms presented by hysterical patients represent a solution to their repressed sexual wish and its conscious expression. The conversion mechanism allows the purely psychic symptom to be converted or transformed into somatic symptoms. Freud stated that the symptoms of hysteria could only be understood if they were traced back to traumatic experiences, and such psychic traumas would involve the patient's sexual life. The factors

causing hysteria predominantly happen during the childhood.

The signal anxiety is formed when stressful situations or psychic anxiety are experienced, thus becoming an alert mechanism against the possibility of a traumatic situation. It is defined as a part of unconscious mental processes accounted for signalling the danger in an anticipatory way. These unconscious anticipatory processes are the general characteristics of the mind, including responses to either real or imaginary (neurotic) situation. The neurophysiological structures and processes associated with unconscious anticipation are only beginning to be understood in human beings²².

The experimental animal models have been of considerable value in understanding the mechanisms involved in gene-environment interaction. In a series of innovative experiments with sea slugs (*Aplysia*), Kandel²³ demonstrated how synaptic connections can be permanently altered and reinforced by regulating the gene expression responsible for the environmental learning. The number of synapses can be increased two-threefold as the result of learning. Likewise human beings, *Aplysia* exhibits behavioural states resembling anticipatory anxiety in response to adverse environmental conditions as well as chronic anxiety in response to sensitiveness. Kandel postulates that studies of anxiety in monkeys and rats are well known, but the advantage regarding the research involving invertebrate animals resides in the fact that their nervous systems are not so complex, thus allowing molecular and cellular mechanisms to be explored.

Huang and Redmond²² have described the role of locus coeruleus in determining the levels of stimulus. It seems that the locus coeruleus serves as a pathway for all sensory stimuli, which are processed by both association cortex and limbic system and then are returned to the locus coeruleus, where information is integrated and sent to frontal cortex, whereas the effector pathways change the activity of the autonomous system. Based on such

events, Hung describes a possible signalling mechanism of anxiety.

Shear, Fyer and Ballg²⁴ have showed that lactate-induced panic attacks can be effectively reverted by cognitive therapy, that is, patients with panic disorders who had experienced attacks precipitated by lactate injection before the treatment did not have any other crisis following the therapy.

Schwartz *et al.*²⁵ have demonstrated, by means of PET (positron emission tomography), that alterations in the metabolic rates of glucose occurred in the caudate nuclei of obsessive-compulsive patients who had been submitted to cognitive-behavioural therapy. They observed a significant decrease in the metabolic rates of glucose in areas of caudate nucleus, thalamus, and orbital gyrus of patients receptive to therapy.

The Finnish investigators Viinamaki and Kuikka²⁶ showed that psychodynamic therapy may have a significant impact on the serotonin metabolism as evidenced in a case study of a 25-year-old man with borderline personality and depression. By using single photon emission computed tomography (SPECT), they observed that the patient after receiving psychotherapy had exhibited normalised levels of serotonin reuptake in both prefrontal and thalamus.

In studies of depression, Sachar²⁷ was one of the first authors to demonstrate the events occurring in the hypothalamus-hypophysis axis in depressed patients. More than 50 percent of all patients with depression had high levels of glucocorticoids. Subsequent studies have showed that high levels of glucocorticoids are associated with a decrease in the number of glucocorticoids receptors, which affects the dexamethasone suppression test. Joff, Segal, and Singer²⁸ demonstrated that cognitive therapy can influence the thyroid hormone levels in patients with major depression, and those who are receptive to the cognitive-behavioural therapy exhibited remarkably decreased levels of thyroxine (T4), whereas the non-receptive patients showed an increase.

4) THE NEUROBIOLOGY OF ATTACHMENT

The early studies on the importance of parent-child relationships were carried out by Anna Freud, who described the traumatic effects of separation during the World War II²⁹.

Spitz³⁰, in his study on the influence of early maternal separation, compared two groups of children separated from their mothers: one group was raised in an orphanage and the other was cared by their mothers in prison. At the end of the first year, the results regarding motor and intellectual development were found to be inferior in the group of children living in the orphanage. Likewise, Harlow³¹ carried out studies on monkeys which had been separated from their mothers and isolated during a period of 6-12 months, being allowed to live together with other monkeys after this period. Although the experimental animals were physically healthy, it was observed that they exhibited unstructured behaviours and did not interact with other monkeys, avoiding fighting, playing or even sexual interest.

John Bowlby²⁹ has formulated the hypothesis of infantile defence – denominated by him as “system of connection” – that likewise hunger and thirst, works as an innate instinct accounted for organising the child’s memory process and promoting proximity and communication with the mother. From an evolutionary point of view, such a system represents an increase in the survival likelihood as the child’s immature brain is allowed to use the mother for organising the memory process through emotional responses, which either reinforces a positive emotional state or alleviates a negative emotional state of the child so that protection and safety are obtained whenever necessary.

Hofer³² was able to show long and short term physiological and behavioural changes in experimental rats which had been previously separated from their mothers, including circadian rhythm and changes in cerebral and hormonal enzymes. The implications resulting from such a study can reflect the individual experiences during

childhood, which will affect the physiology in adulthood. This happens because the homeostasis process also develops as the child grows, although there is evidence suggesting that the growing process needs interpersonal relationships until adulthood. Therefore, the accumulated maternal effects seem to alter the cerebral structure in terms of self-regulation. The comprehension of the attachment formation as a biological phenomenon raises questions about the nature and the possible reversibility of personality deficits as well as about the function of the therapeutic relationship in attempting to revert such deficits.

Sapolsky³³ has demonstrated that high levels of glucocorticoids due to prolonged separations adversely affect hippocampus so that repeated exposures to stress increases the glucocorticoid levels, thus leading to neuronal atrophy which may be irreversible if prolonged. Within the same context, Stark, Gebarski, Berent, and Schteingart³⁴ studied patients with Cushing’s Syndrome and they pointed out that those patients carrying such disease for more than 1 year had selective atrophy of the hippocampus and concomitant lack of memory. This atrophy was also similarly described by Bremner³⁵, who studied the post-traumatic stress disorder and found declarative memory deficits as well as 8% reduction of the right hippocampus in war veterans and patients physically and sexually abused during childhood.

The impact of environmental factors on gene expression can explain the phenotypic differences between identical twins and the disparity regarding disorders like schizophrenia. Reiss, Hetherington, and Plomin³⁶ have studied 708 families: 93 families with at least one pair of adolescent monozygotic twins of the same sex, 99 families with dizygotic twins, 95 families with non-twin siblings, 110 cases involving siblings with the same father, and 130 families with siblings with no genetic connection. Conflicting and negative behaviour towards adolescents accounts for almost 60% of the variance in antisocial behaviour and 37% of the variance in depressive symptoms. It was

observed that parental aggressiveness tends to determine the child coercion, which seemingly promotes the development of dendrites so that cognitive schemes for mental representations can be achieved. The neuronal connections between cortex, limbic system, and autonomic nervous system are linked to consistent connection patterns derived from environmental stimuli, that is, children of the same family can interact very differently with their parents and have distinctive outcomes as well.

Perry, Pollard, and Blakeley³⁷ have stated that trauma in the early childhood can alter the structures of mesencephalus in the system limbic and the brain stem by modifying the alarm reactions. They also observed that the cortical development can be delayed by experiences of negligence and early privation, thus restringing the modulation and response of cortex, limbic system, brain stem, and mesencephalus to situations of fear and danger.

Bremmer³⁵ have shown that adults with post-traumatic stress disorder who were physically and sexually abused during childhood had their left hippocampus significantly reduced in comparison to the control group. It is possible that traumatic experiences during unsteady periods of the brain development may render a form of regression to a more primitive neuronal phase in terms of function and structure. A longitudinal study by Putnum and Trickett³⁸ comparing sexually abused girls to non-abused controls indicated that the former had their dynamic regulation of the neuroendocrine systems changed, thus affecting the neuroendocrine response to stress. Also, the corticotropin-releasing hormone (CRH) was found to be hyper-secreted, which induced to an adaptative "down-regulation" of the receptors in the anterior hypophysis.

Cloninger, Svrakic, and Prybeck³⁹ have developed a psychobiological model of character and temperament consisting of four dimensions for the former and three dimensions for the latter. Based on an extensive genetic research, the authors determined that the four temperament dimensions (novelty-seeking, harm avoidance, reward depen-

dence, and persistence) are inherited in 50-60% of the cases and expressed during the early life, involving perceptive memory and habit formation. The other half of personality is determined by trait variables (self-directedness, cooperativeness, and self-transcendence) which are shaped by the family and matured during adulthood, thus influencing personal and social performance through the insights into self-concepts. Temperament tends to be highly unsteady over time and less receptive to psychotherapy, whereas character is more flexible and responds more favourably to psychotherapeutic interventions.

CONCLUSION

Psychotherapy should accept that, as new advances in neurobiology take place, it plays an important role in the mental activity of the patient because of its capacity of transforming both synaptic activity and information processing. Therefore, further studies can demonstrate that psychotherapy can literally change the brain structure by altering the information storage acquired during the individual's whole life, by changing the process of memory consolidation and leading to persistent synaptic modification, by remodelling cortical maps, and by yielding new inner representations of the self. The capacity for effective self-regulation is minimum at birth, developing along with the experiences of attachments to significant figures^{10,40,41}.

It is thought that psychological activity depends on the neural activity. Therefore, psychotherapeutic practice is expected to modify the functioning of the neural activity. Despite quitting the neurological language at a given moment and replacing it with a psychological language, Freud still believed in the biological basis of the psychoanalysis, which had been established as a natural science, and stated that one day his hypotheses would be explained by the biology. In this sense, neuroscience has been experimentally demonstrating a correlation between neurological

and psychological phenomena so that the brain/mind continuum can be consensually established^{17,42,43,44}.

The correlation between psychoanalysis and neuroscience is not intended to indicate a psychoanalytic practice different from that established by Freud, but to find scientific basis for the reasons why analyst-analysand relationship as well as the mother-baby relationship are so important by reviewing neuroscientific studies of development and socio-emotional interactions. The neuropsychanalysis, therefore, aims to be a movement where both psychoanalysts and neuroscientists can truly meet to investigate and discuss their correlation so that a scientific basis for psychoanalysis and neuroscience can be established^{45,46}.

Despite traditionally existing an isolationist stance among the psychoanalysts regarding other disciplines, Kandel showed how psychoanalysis can contribute in terms of subjectiveness whereas neuroscience can provide the scientific basis for the psychoanalytic theories without the need to eliminate the psychoanalytic setting^{16,47,48}.

Nowadays, it seems nonsense to think of mental states unrelated to specific cerebral conditions, although their correlation is not yet fully understood.

Psychoanalysis employs investigative methods and language very different from those of neuroscience. Efforts by scientists and psychoanalysts have been recently made in order to reduce the gap between both disciplines. Advances in neuroscience can contribute for the acceptance of psychoanalysis as a therapeutic modality provided that the latter is contextually viewed as part of a brain-mind continuum, thus avoiding any isolationism attitude. During many years psychoanalysis has gathered a vast knowledge and experience base regarding the subjective field of emotions which will likely contribute for the comprehension of mental diseases. The continued efforts will most certainly end up improving treatment, satisfaction, and well-being of the mentally-ill patient^{11,12,16,46}.

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