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Review Paper

Linking neuroscience and psychoanalysis from a developmental perspective: Why and how?

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ABSTRACT

This paper aims to develop the rational to support why and how we should link neuroscience and psychoanalysis. Many of these points are derived from child development and child psychiatry. Neuroscience investigates developmental questions in a different way than psychoanalysis, while psychoanalysis itself has shifted towards new developmental paradigms. The rapprochement between neuroscience and psychoanalysis allows a new understanding of some concepts, including embodiment of mind, consciousness and attachment. The "double reading" paradigm allows a better understanding of symptomatic configurations. Linking neuroscience and psychoanalysis may improve treatments and result in new experimental neuroscientific paradigms involving changing the research object, changing the state of the research object, and investigating the structural changes in the brain following psychotherapy. The last aim is to create an epistemology of the articulation between the theoretical frameworks through phenomenology, "complementarism" and neuropsychoanalysis. We argue that it is necessary for clinicians to be aware of the advancements in each field. This is not only an epistemological question; we assume that new findings in neuroscience will change the way psychoanalysts think and approach treatment of their patients. We hope the present research will contribute to change the way that neuroscientists think and will provide new options to their set of experimental paradigms.

Contents

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1. Introduction

Over the past 15 years, a number of papers have attempted to link neuroscience and psychoanalysis.[1] Numerous books on the topic have also been published; in fact, it is difficult to refer to all of them in this review as their number is constantly growing (Couvreur et al., 1996; Hochmann and Jeannerod, 1996; Virole, 1995, 2006; Shevrin et al., 1996; Lechevalier and Lechevalier, 1998; Harris, 1998; Siegel, 1999, 2007; Folensbee, 1999; Pally, 2000; Kaplan-Solms and Solms, 2002; Solms and Turnbull, 2002; Cozolino, 2002; Schore, 2003a; Levin, 2003, 2009; Green, 2003; Corrigall and Wilkinson, 2003; Ansermet and Magistretti, 2004; Pommier, 2004; Ramachandran, 2004; Mancia, 2006; Stora, 2006; Blackmore, 2006; Naccache, 2006; Mayes et al., 2007; Pragier and Faure-Pragier, 2007; Sasso, 2007; Folensbee, 2007; Bazan, 2007; Falissard, 2008; Laurent, 2008; Jurist et al., 2008; Talvitie, 2009; Ouss et al., 2009; etc.).

Their common concerns are the following:

- the importance of interactional epigenesis in the shaping of the brain, based on data about brain plasticity above all in the infant, but also throughout life;
- the importance of early trauma and attachment models as key conceptual paradigms that illustrate this early epigenesis;
- the importance of memory processes in the shaping of later psychopathological disorders;
- the balance between a predictive approach (early influences of the environment on later psychopathology) and the investigation of therapeutic effects based on an epigenetic model;
- a positive view of the mutual influences between the two disciplines and the claim that their theoretical links are of therapeutic interest;
- therapeutic propositions based on new neuroscientific knowledge. Therapeutic interventions are sometimes described from a multidisciplinary and eclectic perspective using techniques from psychoanalysis, cognitive science, and rehabilitation, within an integrative framework;
- an analogy between the mother–child and therapist–patient communication modes as "biopsychologically attuned dyads", emphasizing the importance of infraverbal communication (emotional, embodied communication);
- questioning of the theoretical framework of psychoanalysis built largely on language-based phenomena.

This new epistemological field thus represents quite a challenge! In this paper we propose, from a child development perspective, six reasons and means to connect neuroscience and psychoanalysis.

2. Interests to connect neuroscience and psychoanalysis

2.1. Neuroscience investigates the field of development in a different way

Two opposite tendencies explain why neuroscience and psychoanalysis are combining in the field of development. Development is being conceptualized more and more as open to early environmental influences, and psychoanalytic models are becoming more and more rooted in early development, giving up what we call "adultomorphism".

In the past, the developmental models were predictive, moving from a gene to a phenotype. The two major processes that characterize the new models are epigenesis (Meaney and Szyf, 2005) and plasticity (Ansermet and Magistretti, 2004), phenomena that arise during early fetal development. Development is now understood as a complex transactional system in which genotype, phenotype and the environment have bidirectional effects (Sameroff and Mackenzie, 2003). Gottlieb's "probabilistic epigenesis" (2007) proposes a fourth level-model including gene activity, neural activity, behavior and environment. These dynamic models are extensions of the theory of complexity (Morin, 2008). Variability is an inherent quality of these systems, a stabilization factor that allows an infinite diversity. Variability is thus a developmental factor in itself: one cannot predict what will happen at time t because what will happen at $t+1$ depends on what happened between t and $t+1$, which may have bidirectional probabilistic effects on t and $t+1$. Such systems cannot be reduced to their elements. A closed system is not viable and tends to disappear. In addition, it is extremely difficult to measure control parameters of such systems as they belong to both the subject and the environment (Pêcheux, 2004).

On the other hand, psychoanalysis has shifted from an abstract and theoretical reconstruction of early life to an account that incorporates the reality of very early experience between mother and child (Klein et al., 1952; Bion, 1962; Boston Change Process Study Group[2]), shifting from drive and infantile sexuality (Holmes, 1998; Green, 1995) as key motivations and concepts, to emotion, object relation (Meltzer, 1975; Tustin, 1981; Sander, 1987; Hobson, 2002; see Fonagy and Target, 2007 for a review) and self construction (Stern, 1985).

These complex models have a great influence on the way we conceive of and study development.

2.2. A new reading of the concepts of consciousness, embodiment of mind and attachment

2.2.1. Embodiment of mind, consciousness and enactive mind

The concept of embodied mind has been developed by several authors (Fonagy and Target, 2007; Klin and Jones, 2007) and is similar to the concept of enactive mind (Varela et al., 1991).

The data now available on early skills and, above all, on the effects of early interactive and affective experiences of newborns and infants have completely changed our understanding of the emergence of mind, consciousness, and cognitive processes. Recent developmental data have narrowed the classical gap between mind and body and have provided arguments for the rootedness of mental structures in early sensory and affective experiences.

In his "psychobiologically attuned dyad", Schore (2003b) considers the caregiver as an "experience-dependent" external biopsychological regulator of the infant's brain system. Trevarthen and Aitken (2001) proposes a dialogue between the internal vagal-limbic emotional system of self and the diencephalic neocortical cognitive system, which regulates the relationship with the environment. The emerging-self treats the caregiver's signals and records the changes in the proto-self, responding to nonverbal signals (Damasio, 1999).

This biopsychological attunement is certainly related to the mirror systems (Rizzolatti et al., 2001), which are active during motor acts as well as motor imagery, sensory cues and complex emotions; Goldman and Sripada (2005) speak about "resonance without mediation" or "direct experience-dependent understanding" (Gallese, 2005).

2.2.2. Attachment as a regulatory system

Schore and Schore (2008) propose to transform attachment theory into a theory of affect regulation. Schore has developed most of his work on the influence of early interactive impairments on the right brain (namely the limbic and paralimbic regions) and on

[1] (153 papers, 90 published in the last 10 years and catalogued in PUBMED)

[2] http://www.changeprocess.org/

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attachment constitution. Early experiences of trauma and abuse should have effects, via ontogenesis, on the development of the brain structures that underpin attachment.

Fonagy and Target (2007) offer a very interesting bridge between attachment and psychoanalysis through the advancement of cognitive science. They first propose that "Speculations about the nature of language ... emphasize the origin of internal working models (and of representations in general) in early sensorimotor and emotional experiences with a caregiver. It is argued that language and symbolic thought may be phylogenetically and ontogenetically embodied, built on a foundation of gestures and actions, and are thus profoundly influenced by the experience of early physical interaction with the primary object."

The following neuroscientific experiments support their theory of mentalization. Attachment is considered as a type of "addictive disorder": the mesocorticolimbic dopaminergic reward circuit is activated in attachment situations (Insel, 1997, 2003). There is a similitude between the areas and neuromediators involved in maternal (Nitschke et al., 2004) and romantic love (Bartels and Zeki, 2000). Bartels and Zeki (2004) show that activation of the brain areas involved in attachment in turn deactivates areas involved in negative emotions, social judgment and mentalization. Being in an activated attachment state, such as the one elicited by early trauma, should therefore simultaneously inhibit mentalization (Fonagy and Target, 2008).

Attachment may serve as a paradigmatic concept (Holmes, 1998) on which a rapprochement between psychoanalysis and neuroscience could be built.

2.3. A better understanding of symptomatic configurations: The double reading paradigm

"Is it neurological (or cognitive) or is it psychopathological?" is a frequently asked question in child clinical psychopathology. Is it mind or brain? Is it defect or defense? This leads to tough competition between the cognitive behavioral and psychoanalytic schools of thought.

The paradigm of "double reading" provides an interesting and different way to ask this question. It assumes that for many developmental disorders, we can say both that neuropsychological disorders have a psychopathological expression and affect the constitution of the inner world and that psychopathological problems have a brain substratum. In this framework, a symptom can be considered both as an instrumental impairment and as a psychic defense. The double reading is a systematic way to consider both aspects as necessary, but not simultaneously. We will further explain how to employ this systematic method. This principle is used in our clinical evaluations of developmental disorders. Our research program (PILE, Necker hospital) proposes to study at-risk babies in the context of seven axes: medical, developmental, neuropsychological, psychopathological, attachment, psychodynamic and interactive.

From a developmental perspective, this framework allows one to conceive the links between environmental influences and their early effects on brain development, which in turn have effects on behavior and on the environment. For example, Field and her team (Jones et al., 1997; Field et al., 2006) demonstrate, in a bottom-up model, how the infants of depressed mothers show frontal EEG asymmetry at 3–4 months during interactions with their mothers. At 3 years old, they show the same pattern and are more inhibited during an exploratory play task and less empathetic during simulated maternal distress than children of non-depressed mothers. The effects of maternal depression are more severe for prenatal than for postnatal depression. Infant's inhibited behavior may influence the way the mother responds to the child, creating a negative transactional spiral.

2.4. Towards improved treatments

2.4.1. An Integrative clinical view

We propose an integrative clinical view. Some authors (Cozolino, 2002; Siegel, 1999, 2007; Schore, 2003a,b) set out pragmatic propositions of an integrative view. Schore puts forth 20 "Principles of the psychotherapeutic treatment of early-forming right hemispheric self-pathology based upon the developmental models of Schore's regulation theory". Cozolino discusses six reasons why neuroscience can influence psychotherapeutic processes.

The double reading approach allows targeted, but not concurrent, interventions. How can we conceptualize such a therapeutic intervention while taking these two frameworks into account? One way involves integration within the therapist, in «one head». The questions that remain are: Is it possible and useful to introduce neuroscientific knowledge into therapy? Will it modify the therapeutic setting and technique? Or does it imply another type of therapy or setting? We propose a specific method in which the choice between two targets will depend on the nature of the disorder, its appearance, and its place in the patient's psychic economy. Countertransference offers a useful tool by which to differentiate cognitive impairments and defense mechanisms. The Holmes "binocular vision" (1998) enables the therapist both to engage with the patient and to be aware of the nature of this engagement and belongs to this "one head, two eyes" vision. The other way is to imagine two clinicians (a cognitivist and a psychoanalyst) who collaborate to treat the patient: a "two heads" position. This would involve using a more classical teamwork technique and would require establishing a language compatible with both cognitive neuroscience and psychoanalysis.

2.4.2. Analogies between parent–infant and therapist–patient relationships

The therapist–patient relationship can be considered as the same kind of psychobiologically attuned dyad as the mother–infant dyad, in which intersubjective experiences are important. Schore uses neurobiological metaphors to describe this attunement: "I suggest that just as the left brain communicates its states to other left brains via conscious linguistic behaviors, so the right nonverbally communicates its unconscious states to other right brains *that are tuned to receive these communications*" (Schore, 2003b, p. 76).

The concepts of embodiment and enactive mind are good primary tools for establishing a psychobiological attunement between patient and therapist. We can call this "somatic countertransference" (Lebovici, 1998). Projective identification has already been described as an infraverbal mean of communication (Bion, 1962; Schore, 2003b). The state in which the therapist receives projective identification is analogous to maternal receptivity, an attuned biopsychological state that is coherent with attachment theory and neurobiological advances. These considerations are of importance in the pragmatic setting of therapy. The aims and means of the therapy should shift (Holmes, 1998) to place more focus on the "vertical" splitting of the self than on repression, shifting from "past unconscious" to "present unconscious" (Sandler and Sandler, 1984) and from transferential repetition to new experience. Attachment offers a relevant framework in which to formulate these modifications.

2.5. Changing experimental neuroscientific paradigms

2.5.1. Changing the research object

The cognitivists' objects of research have shifted in recent years. Cognitivists have shifted from a monadic point of view to a social cognition-based view, from a computer metaphor to an ecological approach, from a third-person to a first-person perspective, from

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the measurement of external objectivity to internal subjectivity, and from a mind-brain separation to an "embodied" cognition (Varela et al., 1991; Fonagy and Target, 2007). We propose that cognitivists should study the relation process itself, in the same way as those who have attempted to describe a "neuroscience of psychotherapy" (Schore, 2003a; Siegel, 1999, 2007; Cozolino, 2002). Gerber and Peterson (2006) propose an experimental "transference paradigm" to be studied using functional magnetic resonance imaging (fMRI) that could provide evidence for what happens in the brain during therapy. These experiences are interesting first steps, although the experimental setting is quite far from ecological conditions. We have proposed to study what happens during the "co-construction" (Widlöcher, 1996) process of psychotherapy in separating the processes of co-associativity (HOW do I think with my patient?), co-thinking (WHAT do I think with my patient?), and enactment (What do I bodily FEEL with my patient?); this is close to what Fonagy and Target (2007) call the "metaphoric structure of language". Our hypothesis is that the patient transmits his thinking processes to the therapist in a similar, analogical form. It could be useful to construct a "co-thinking" paradigm or countertransference evaluation, which could provide us with much information about what happens in the patient's and therapist's minds during therapy. The therapist's mind is an excellent informer of this process: "The 'cognitive' component is largely the responsibility of the analyst whose job is to translate his/her countertransferential perceptions into interpretations" (Holmes, 1998). Viewed in this manner, cognitive processes among therapists are important topics of research.

2.5.2. Changing the state of the research object

Almost all paradigms in fMRI are constrained to investigate a specific cognitive, perceptive or emotional task, usually in a context far from its ecological state. Raichle et al. (2001) proposes considering resting state networks as specific patterns of activation that provide information about the brain's activity at rest, i.e., what happens most of the time. Margulies (2008) proposes an interesting experiment in which resting states are correlated with personality traits assessed with personality scales. This is one of the most interesting approaches for future experiments.

2.5.3. Investigating structural changes following psychotherapy

Neural plasticity, the phenomenon of reconsolidation (Alberini et al., 2006), and the concept of "trace" (Ansermet and Magistretti, 2004) all support arguments that suggest that environmental actions such as psychotherapy change the brain's neural circuitry. For this reason, psychotherapy and its theoretical framework, psychoanalysis, are of importance to inflect neuroscientific paradigms. Some research has already shown the effect of psychotherapies on brain activity (Furmark et al., 2002; Paquette et al., 2003; Goldapple et al., 2004; Straube et al., 2006; for a review, see Roffman et al., 2005; Linden, 2006, 2008, and Brody et al., 2001). Different treatments (psychotherapy and medication) have similar effects, though they work through different mechanisms: top-down for drugs, bottom-up for psychotherapy. This research is of interest for two reasons: first, it illustrates that epigenesis includes the effect of relational actions; second, it aims to show that therapy (also) changes the brain's state, or perhaps its structure.

2.6. Creating an epistemology of the articulation between the two theoretical frameworks

Three ways to articulate the frameworks of psychotherapy and neuroscience can be proposed.

The first is phenomenological. Since the Merleau-Ponty work (1945), phenomenology has lost its influence, probably due to developments in experimental brain research. However, research in genetics shows that the precise description of phenotypes is of primary importance in defining genetic patterns. These phenotypes should include the value of one's understanding and feeling of what happens in one's mind and in body. Phenomenology offers a valuable framework for this thinking. One of the most important tasks is construction of a "baby phenomenology". Scientific understanding of the early infant's internal world has still remained a theoretical reconstruction based on that of the adult, rather than being built based on experimental data. The Rochat studies on the construction of the self in the infant (2009) seem adequately close to a phenomenologic approach.

The second framework is "complementarism" (Devereux, 1972). This neologism was first used in an ethnopsychiatric framework. Devereux describes a position that necessarily takes into account two theoretical frames, but not simultaneously. Successive shifts allow one to take a position, and then another. This is not a choice; it is a necessary position, an inevitable methodology that allows one to study the same object from two different points of view without equating one to the other. This framework seems among the most relevant.

The third is neuropsychoanalysis. This is not a new discipline, but most likely a descendant of "complementarism", a way to study a single object from two perspectives, the neuroscientific and the psychoanalytic. This neologism was created about 10 years ago by Solms. Neuropsychoanalysis (NPSA) was first based on the study of brain-injured patients. Kaplan-Solms and Solms (2002) referred to the Luria and Freud work as they found that their understanding of their patients was enriched by these theories. Luria's proposal of a "dynamic neuropsychology" and Freud's analysis of the unconscious were found compatible by Solms and he used these two tools for treatment of his patients. NPSA was then extended to a more general method of considering the exploration of the brain substrata of conscious and unconscious mental processes and their relationships. Northoff et al. (2007) proposed a dialectic between a first-person perspective and a third-person perspective that includes two levels of investigation: the mind, with its unconscious part, and the material part that underpins it, the brain.

3. Conclusion

We have tried to develop many reasons to support why and how we should link neuroscience and psychoanalysis. Many of these reasons are derived from child development and child psychiatry. We think it is necessary to be aware of the advancements in each field. Fédida (1990) proposes that we should be malleable and let ourselves be distorted by other theories without forgetting their fundamental heterogeneity. This is not simply an epistemological question; we assume that new findings in neuroscience will change the way psychoanalysts think and treat their patients. We hope this approach will also change the way neuroscientists think and will affect their choice of experimental paradigms.

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