aptara | NYAS | nyas_04474 | Dispatch: 2-12-2009 | CE: N/A
Journal | MSP No. | No. of pages: 15 | PE: Amanda/Carey
SELF AND SYSTEMS

Relational Trauma and the Developing Right Brain

An Interface of Psychoanalytic Self Psychology and Neuroscience

Allan N. Schore

Department of Psychiatry and Biobehavioral Sciences, University of California, Los Angeles, David Geffen School of Medicine, Los Angeles, California, USA

Psychoanalysis, the science of unconscious processes, has recently undergone a significant transformation. Self psychology, derived from the work of Heinz Kohut, represents perhaps the most important revision of Freud's theory as it has shifted its basic core concepts from an intrapsychic to a relational unconscious and from a cognitive ego to an emotion-processing self. As a result of a common interest in the essential, rapid, bodily based, affective processes that lie beneath conscious awareness, a productive dialogue is now occurring between psychoanalysis and neuroscience. Here I apply this interdisciplinary perspective to a deeper understanding of the nonconscious brain/mind/body mechanisms that lie at the core of self psychology. I offer a neuropsychoanalytic conception of the development and structuralization of the self, focusing on the experience-dependent maturation of the emotion-processing right brain in infancy. I then articulate an interdisciplinary model of attachment trauma and pathological dissociation, an early forming defense against overwhelming affect that is a cardinal feature of self-psychopathologies. I end with some thoughts on the mechanism of the psychotherapeutic change process and suggest that self psychology is, in essence, a psychology of the unique functions of the right brain and that a rapprochement between psychoanalysis and neuroscience is now at hand.

Key words: **neuropsychoanalysis; right brain; trauma; dissociation; unconscious; attachment**

Introduction

At the present time a number of scientific and clinical disciplines are simultaneously experiencing a rapid expansion of relevant data and even a reorganization of their underlying theoretical concepts. Indeed, the term paradigm shift is appearing in a number of literatures. Although current significant advances in various technologies and the computer sciences have catalyzed this growth spurt, an important contributor has been the rapid communication of information not only within but also between disciplines. In this period of accelerated growth of essential information about the human condition and the natural world, the transfer of knowledge across disciplinary boundaries is occurring at a faster rate. This trend is reflected in an increasing interest in interdisciplinary studies and in integrated models that synthesize data generated at the interface of different scientific and clinical fields.

Within this context there exists a potential for new and fresh solutions to certain fundamental problems, especially those concerning the essential mechanisms that lie at the core of adaptive and maladaptive human functions. Until very recently these problems have been studied from the unique vantage points of

Address for correspondence: Allan N. Schore, 9817 Sylvia Avenue, Northridge, CA 91324. Voice: 818-886-4368; fax: 818-349-4404. anschore@aol.com

Self and Systems: Ann. N.Y. Acad. Sci. xxxx: 1–15 (2009).
doi: 10.1111/j.1749-6632.2009.04474.x

various scientific perspectives that span the sociological, psychological, biological, and chemical domains. The over emphasis on specialization within each of these disciplines has also fostered their isolation from one another, which has in turn inadvertently increased an artificial dichotomous separation between, for example, psychology and biology, brain and mind, mind and body, cognition and emotion. Earlier impermeable boundaries of knowledge between disciplines also intensified a tension and indeed a conflict between those studying unconscious involuntary processes and those studying conscious voluntary processes, that is between psychoanalysis—the science of unconscious process—and psychology—the study of behavior.

This ambivalent relationship between psychoanalysis and the other sciences has existed since its creation by Sigmund Freud. And yet it is often forgotten that Freud's early career was in neurology and that in 1895 he wrote *Project for a Scientific Psychology*, an attempt to create "a psychology which shall be a natural science" (Schore, 1997). In this remarkable document Freud used what was then known about neurophysiology and biology to begin to construct a set of regulatory principles for psychological processes and a neuropsychological model of brain function. Freud did not publish the *Project* in his lifetime and over the course of his career never returned to the problem of creating a model that could integrate the biological and psychological realms. And yet he predicted that at some point in the future "we shall have to find a point of contact with biology" (Freud, 1913). Freud thus saw neurobiology as a discipline that could bridge the gap between biology and psychoanalysis, especially in the study of the unconscious and its fundamental impact on all aspects of the human experience.

Over the course of the last century, a number of significant transformations have occurred in Freud's theory, although much of this work has not transferred outside of the field. The theoretical core of psychoanalysis, almost unchanged for most of its first century, is now undergoing a substantial reformulation from an intrapsychic unconscious to a relational unconscious whereby the unconscious mind of one communicates with the unconscious mind of another. The scaffolding of clinical psychoanalysis is supported by conceptions of psychic development and structure, and it is these basic concepts that are now being reformulated. Self psychology, emergent from the seminal work of Heinz Kohut, represents perhaps the most significant updating of classical psychoanalysis since it inception. In 1971, Kohut, trained in neurology and then psychoanalysis, published his classic volume *The Analysis of the Self* , a detailed exposition of the central role of the self in human existence. He subsequently expanded the theoretical framework of self psychology in a second volume, *The Restoration of the Self* (1977), and finally in *How Does Analysis Cure?* (1984).

In all his clinical work and writings Kohut attempted to explore the four basic problems of psychoanalysis that he initially addressed in his seminal volume: how do early relational affective transactions with the social environment facilitate the emergence of self (*development of the self*); how are these experiences internalized into maturing self-regulating structures (*structuralization of the self*); how do early deficits of self-structure lead to later self-pathologies (*psychopathogenesis*); and how can a therapeutic relationship lead to a restoration of self (*mechanism of psychotherapeutic change*).

Despite the fact that he was originally trained as a neurologist, Kohut was highly ambivalent about the incorporation of scientific data into the core of psychoanalytic self psychology. Indeed, like Freud before him, he eschewed his earlier neurological knowledge and attempted to create a purely psychological model of the unconscious systems that underlie all human functioning. However, in the last 10 years, over the course and since the "decade of the brain" an interdisciplinary perspective has emerged both within psychoanalysis and the disciplines that border it. Because of a common interest in the essential, rapid, bodily based, affective

processes that lie beneath conscious awareness, a productive dialogue is now occurring between psychoanalysis and neuroscience. This convergence has facilitated the emergence of a new discipline, neuropsychoanalysis, and a subspecialization, developmental psychoanalysis (Schore, 1997). This discipline returns to Freud's attempt to create "a psychology which shall be a natural science" by specifically focusing on the essential psychobiological role of the unconscious in all human affect, cognition, and behavior.

In a number of works I have suggested that the time is right for a rapprochement between psychoanalysis and the biological sciences (Schore, 1994, 1997, 2002a, 2002b, 2003, 2005a). In this period when neuroscience is "rediscovering the unconscious", neuropsychoanalysis is identifying the "intrapsychic" brain systems involved in a redefined dynamic unconscious and developmental psychoanalysis is generating a complex model of the social–emotional origins of the self and the early ontogeny of the biological substrate of the human unconscious. It is now clear that Freud was correct in positing the unconscious mind develops before the conscious and that the early development of the unconscious is equivalent to the genesis of a self-system that operates beneath conscious verbal levels for the rest of the life span. I believe a deeper understanding of early human development can never be attained by narrowly focusing infant studies on the precursors of language, conscious thought, and voluntary behavior.

A complete model of human development (and psychoanalysis) can only be psychobiological, not merely psychological. A deeper understanding of one of the fundamental questions of science, why early developmental processes are essential to the short- and long-term survival of the organism, will not come from single or even multiple discoveries within any one discipline (Schore, 1994). Rather, an integration of related fields is essential to the creation of a heuristic model of both developmental structures and functions that can accommodate and interpret the data of various biological and psychological disciplines and can freely shift back and forth between their different levels of analysis.

In this chapter on the integration of self psychology and neuroscience, I outline my neuropsychoanalytic work on the interpersonal neurobiological origins of the self. I first present a brief overview of Kohut's concepts that represent the core of self psychology. Subsequently I integrate interdisciplinary data in order to construct a neuropsychoanalytic conception of the *development* and *structuralization* of the self, focusing on the experience-dependent maturation of the early developing right brain. Then, in a major focus of this work, I apply this developmental neuropsychoanalytic perspective to the *psychopathogenesis* of severe deficits in the self-system. Citing my work in this area, I articulate a model of the self psychology and neurobiology of early relational trauma and the etiology of pathological dissociation, an early forming defense that is a cardinal feature of a number of early forming psychopathologies. I end with some thoughts on *psychotherapeutic change* and argue that the time is right for a rapprochement between psychoanalysis and neuroscience. Throughout I suggest that the "point of contact with biology" that Freud referred to is specifically the central role of right brain psychobiological processes in the unconscious regulation of affect, motivation, and cognition, areas of intense interest to both contemporary self psychology and neuroscience.

Self-Psychological Developmental Models: Psychobiology of Attachment

Perhaps Kohut's most original and outstanding intellectual contribution was his developmental construct of selfobject. Indeed, self psychology is built upon a fundamental developmental principle—that parents with mature psychological organizations serve as selfobjects that perform critical regulatory functions for

the infant who possesses an immature, incomplete, psychological organization. The child is thus provided, at nonverbal levels beneath conscious awareness, with selfobject experiences that directly effect the vitalization and structural cohesion of the self. The selfobject construct contains two important theoretical components. First, the concept of the mother–infant pair as a self—selfobject unit emphasizes that early development is essentially an interdependence between self and objects in a system. This core concept was a major intellectual impetus for the expansion of the intersubjective perspective in psychoanalysis. Indeed, Kohut's emphasis on the dyadic aspects of unconscious communications shifted psychoanalysis from a solely intrapsychic to a more balanced relational perspective. This challenged psychoanalysis to integrate the realms of a one-person psychology and a two-person psychology.

The second component of the selfobject construct is the concept of regulation. In his developmental speculations, Kohut (1971, 1974) Q5 stated that the infant's dyadic reciprocal regulatory transactions with selfobjects allows for the maintenance of his internal homeostatic equilibrium. These regulating self–selfobject experiences provide the particular intersubjective affective experiences that evoke the emergence and maintenance of the self (Kohut, 1984). Siegel (1996) observes, "Kohut makes major contributions to the understanding of emotional life, and his conceptualizations have far-reaching implications for the understanding and treatment of emotional states." Kohut's idea that regulatory systems are fundamentally involved with affect is supported in current interdisciplinary studies that are highlighting not just the centrality of affect but also affect regulation.

Despite his intense interest in the early ontogeny of the self, over the course of his career Kohut never spelled out the precise developmental details of his model nor did he attend to the significant advances in developmental psychology and psychoanalysis that were occurring simultaneously to his own theorizing. There is now agreement that current psychoanalysis is "anchored in its scientific base in developmental psychology and in the biology of attachment and affects" (Cooper, 1987). At this point in time, self psychology is incorporating a broad range of current developmental research into its theoretical model. In my own contributions to this effort I have integrated recent advances in attachment theory into the field (Schore, 2002, 2003a, 2005b). Q6

Overviewing and integrating this data, it is now established that the essential task of the first year of human life is the creation of a secure attachment bond of emotional communication between the infant and primary caregiver. Research now suggests "learning how to communicate represents perhaps the most important developmental process to take place during infancy" (Papousek & Papousek, 1995). Through visual-facial, auditory-prosodic, and tactile-gestural communications, caregiver and infant learn the rhythmic structure of the other and modify their behavior to fit that structure, thereby co-creating a specifically fitted interaction.

Kohut described critical episodes of "empathic mirroring" in which "The most significant relevant basic interactions between mother and child usually lie in the visual area: The child's bodily display is responded to by the gleam in the mother's eye" (Kohut, 1971). During bodily based affective communications embedded in mutual gaze transactions, the psychobiologically attuned mother synchronizes the spatiotemporal patterning of her exogenous sensory stimulation with the spontaneous overt manifestations of the infant's organismic rhythms. Via this contingent responsivity, the mother appraises the nonverbal expressions of her infant's internal arousal and affective states, regulates them, and communicates them back to the infant. To accomplish this, the primary caregiver must successfully modulate nonoptimal high or nonoptimal low levels of stimulation that would induce supra-heightened or extremely low levels of arousal in the child. Secure attachment depends upon

the mother's sensitive psychobiological attunement to the infant's internal states of arousal.

Importantly, research now clearly demonstrates that the primary caregiver is not always attuned and optimally mirroring, that there are frequent moments of misattunement in the dyad, ruptures of the attachment bond. The disruption of attachment bonds leads to a regulatory failure and an impaired autonomic homeostasis. Studies of "interactive repair" following dyadic misattunement (Tronick, 1989) support Kohut's (1977) assertion that the parental selfobject acts to "remedy the child's homeostatic imbalance." In this pattern of "disruption and repair" (Beebe & Lachmann, 1994), the "good enough" caregiver who induces a stress response through misattunement in a timely fashion reinvokes a reattunment, a regulation of the infant's negatively charged arousal.

In current psychobiological models, attachment is defined as the interactive regulation of states of biological synchronicity between and within organisms (Schore, 2000, 2003a, 2005b). The dual regulatory processes of affect synchrony that creates states of positive arousal and interactive repair that modulates states of negative arousal are the fundamental building blocks of attachment and its associated emotions. These interactive regulatory mechanisms optimize the communication of emotional states within an intimate dyad and represent the psychobiological underpinning of empathy, a phenomenon of intense interest to self psychology. Kohut (1977) deduced that as a result of the empathic merger of the child's rudimentary psyche with the maternal selfobject's highly developed psychic organization, the child experiences the feeling states of the selfobject as if they were his own. Selfobjects are thus external psychobiological regulators that facilitate the regulation of affective experiences, and they act at nonverbal levels beneath conscious awareness in the regulation of self-esteem and the maintenance of self-cohesiveness (Schore, 1994, 2002).

Self-Psychological Models of Structuralization: Links to Interpersonal Neurobiology

A cardinal principle of self psychology dictates that, as a result of optimal self–selfobject relational experiences, the infant becomes able to perform the drive-regulating, adaptive, and integrating functions that had previously been performed by the external object. Kohut specifically posited that phase-appropriate, maternal, optimal frustrations of the infant elicit "transmuting internalization", the developmental process by which selfobject function is internalized by the infant and psychological regulatory structures are formed. Developmental data are consonant with this, although interdisciplinary data emphasize that not just optimal stressful frustration but interactive repair is essential to the formation of a structural system that can regulate stressful affect. The formative experiences of the self are built out of internalized selfobject functions that facilitate the emergence of more complex regulatory structures.

Recent research also support Kohut's speculation that the infant's regulatory transactions with the maternal selfobject allow for maintenance of his homeostatic equilibrium. According to Ovtscharoff and Braun (2001), "The dyadic interaction between the newborn and the mother. . .serves as a regulator of the developing individual's internal homeostasis. The regulatory function of the newborn-mother interaction may be an essential promoter to ensure the normal development and maintenance of synaptic connections during the establishment of functional brain circuits." These researchers conclude that subtle emotion regulating attachment interactions permanently alter the brain by establishing and maintaining developing limbic circuits (Ziabreva *et al.*, 2003).

A large body of studies now clarifies the developmental neurobiology of the selfobject mechanism. In my own work I have suggested that the self-organization of the developing brain occurs in the context of a

relationship with another self, another brain. More specifically, the self–selfobject relationship is embedded in infant–caregiver, right hemisphere to right hemisphere, affective, attachment communications (Schore, 1994, 2000, 2003, 2005a). In light of the observations that the emotion-processing human limbic system myelinates in the first year-and-a-half (Kinney *et al*., 1988) and that the early-maturing right hemisphere (Chiron *et al.*, 1997; Bogolepova & Malofeeva, 2001; Allman *et al.*, 2005; Gupta *et al*., 2005; Sun *et al*., 2005)—which is deeply connected into the limbic system—is undergoing a growth spurt at this time, attachment experiences specifically impact limbic and cortical areas of the developing right cerebral hemisphere (Henry, 1993; Schore, 1994; Siegel, 1999; Cozolino, 2002).

In very recent work on mother–infant emotional communication Lenzi *et al*. (in press) offer data from a functional magnetic resonance imaging study "supporting the theory that the right hemisphere is more involved than the left hemisphere in emotional processing and thus, mothering." Also confirming this model Minagawa-Kawai *et al*. (in press) report a near-infrared spectroscopy study of infant–mother attachment at 12 months and conclude, "our results are in agreement with that of Schore (2000) who addressed the importance of the right hemisphere in the attachment system." Supporting Kohut's speculations on empathic mirroring, neuroscience researchers now conclude that developing children rely upon a "right hemisphere-mirroring mechanism—interfacing with the limbic system that processes the meaning of observed or imitated emotion" (Dapretto *et al*., 2006).

Ongoing neurobiological research on the mother–infant intersubjective dialogue indicates, "A number of functions located within the right hemisphere work together to aid monitoring of a baby. As well as emotion and face processing the right hemisphere is also specialized in auditory perception, the perception of intonation, attention, and tactile information" (Bourne & Todd, 2004). Social experiences thus facilitate the experience-dependent critical period maturation of right brain systems that process visual-facial, auditory-prosodic, and tactile-gestural affective communications. From infancy through all later stages of the life span, the right hemisphere is dominant for the nonconscious reception, expression, and communication of emotion and the cognitive and physiological components of emotional processing (Schore, 2003a, 2003b). With respect to empathy, a core process of self psychology, it is now thought that "self-awareness, empathy, identification with others, and more generally intersubjective processes, are largely dependent upon. . .right hemisphere resources, which are the first to develop" (Decety & Chaminade, 2003).

Furthermore, the "complex psychological regulatory structures" described by self psychology can now be located in "the right hemispheric specialization in regulating stress—and emotion-related processes" (Sullivan & Dufresne, 2006). Indeed, the brain's major self-regulatory systems are located in the orbital prefrontal areas of the right hemisphere that undergo an anatomical maturation in postnatal periods of mammalian development (Bradshaw & Schore, 2007). The experience-dependent maturation of this affect regulatory system is thus directly related to the origin of the self (Schore, 1994). Earlier research documented that the development of the self and self-awareness is reflected in the ability of 2-year olds to recognize their own visual image in a mirror (Amsterdam, 1972). Functional magnetic resonance neuroimaging studies show that when subjects look at an image of their own face, activation seen in occipito–temporo–parietal junction and the right frontal operculum (Sugiura *et al*., 2005), and self-face recognition activates a frontoparietal "mirror" network in the right hemisphere (Uddin *et al*., 2005).

Indeed, a substantial amount of research indicates that the right hemisphere is specialized for generating self-awareness and self-recognition, and for the processing of "self-related material" (Miller *et al*., 2001;

Decety & Chaminade, 2003; Fossati *et al*., 2004; Platek *et al*., 2004; Feinberg & Keenan, 2005; Perrin *et al*., 2005). Neuroscientists now suggest that the essential function of the right lateralized system is to "maintain a coherent, continuous, and unified sense of self" (Devinsky, 2000). Summarizing this knowledge Molnar-Szakacs and colleagues (2005) assert, "Studies have demonstrated a special contribution of the right hemisphere (RH) in self-related cognition, own-body perception, self-awareness, autobiographical memory and theory of mind. Many studies of self-face recognition have also found a RH advantage, suggesting a special role for the RH in processing material related to the self." These data clearly indicate that self psychology is in essence a psychology of the unique functions of the right brain.

Self-Psychological Models of Psychopathogenesis: Negative Impact of Attachment Trauma on the Right Brain

Q9

At the core of Kohut's model of psychopathogenesis is the central hypothesis that the mother's traumatic failures of empathic mirroring lead to enduring defects in the infant's emerging self. Self psychology thus proposes that disturbed physiological regulation results from primary disturbances in selfobject experiences and that a defective self and an impaired regulatory structure lie at the foundation of early forming psychopathologies. Kohut (1971) highlighted the importance of "the role of specific environmental factors (the personality of the parents, for example; certain *traumatic* external events) in the genesis of the developmental arrest," especially when "the mother's response Q10 are grossly unempathic and unreliable. . .no transmuting internalization can take place, and the psyche. . .does not develop the various internal functions which re-establish narcissistic equilibrium."

Although there is a long history of controversy within psychoanalysis, the field is now very interested in the problem of trauma and in the unique survival defenses for dealing with early relational trauma. Laub and Auerhahn (1993) propose that the essential experience of trauma is a disruption of the link between the "self" and the mothering "empathic other", and therefore the maternal introject, or mothering (selfobject regulatory) function, is deficient or "damaged". They further contend "it is the nature of trauma to elude our knowledge because of both *defence* and deficit. . .trauma overwhelms and defeats our capacity to organize it." In line with these self-psychological principles, current neuropsychoanalytic models now posit that, under the impact of developmental trauma, specific defensive and defective regulatory structures develop that lie at the core of the patient's psychopathology (Schore, 2002b).

Psychoanalysis, psychiatry, and developmental traumatology are all now converging on dissociation, the bottom-line survival defense against overwhelming, unbearable, emotional experiences. Longitudinal attachment research demonstrates an association between traumatic childhood events and proneness to dissociation, described as "detachment from an unbearable situation", "the escape when there is no escape", and "a last resort defensive strategy" (Schore, 2003b, in press). Although Kohut never used the term *dissociation*, in his last book (1984) he characterized an early interaction in which the traumatized child "walls himself off" from traumatizing experiences:

> If the mother's empathic ability has remained infantile, that is, if she tends to respond with panic to the baby's anxiety, then a deleterious chain will be set into motion. She may chronically wall herself off from the baby, thus depriving him of the beneficial effect of merging with her as she returns from experiencing mild anxiety to calmness. Alternatively, she may continue to respond with panic, in which case two negative consequences may ensue: the mother may lay the groundwork in the child for a lifelong propensity toward the uncurbed spreading of anxiety or other emotions, or by forcing the child to wall himself off from such an overly intense and thus traumatizing [experience, she] may foster in the child an impoverished psychic organization,

> the psychic organization of a person who will later be unable to be empathic himself, to experience human experiences, in essence, to be fully human.

What can ongoing studies in developmental psychology, affective neuroscience, and neuropsychoanalysis tell us about the neurobiology and neuropsychology of attachment-relational trauma and about dissociation, the mechanism by which humans "wall themselves off" from overwhelming emotional trauma? In this last section I discuss interdisciplinary studies, which indicate that experiences with a traumatizing caregiver negatively impact the child's attachment security, right brain maturation, and sense of self and thereby lay the ground work for the use of pathological dissociation in various self-pathologies.

Developmental Psychobiology of Relational Trauma

During the brain growth spurt, relational, trauma-induced, arousal dysregulation precludes the aforementioned visual-facial, auditory-prosodic, and tactile-gestural attachment communications and alters the development of essential right brain functions. In contrast to an optimal attachment scenario, in a growth-inhibiting relational environment the primary caregiver induces traumatic states of enduring negative affective arousal in the child. This caregiver is inaccessible and reacts to her infant's expressions of emotions and stress inappropriately and/or rejectingly and therefore shows minimal or unpredictable participation in the various types of arousal-regulating processes. Instead of modulating, she induces extreme levels of stimulation and arousal, very high in abuse and/or very low in neglect. And because she provides no interactive repair, the infant's intense negative-affective states last for long periods of time.

Studies in developmental traumatology reveal that the infant's psychobiological reaction to trauma is comprised of two separate response patterns: hyperarousal and dissociation (Schore, 2001, 2002c). In the initial hyperarousal stage, the maternal haven of safety suddenly becomes a source of threat, triggering a startle reaction in the infant's right hemisphere, the locus of both the attachment and the fear motivational systems. The maternal stressor activates the hypothalamic–pituitary–adrenal (HPA) stress axis, eliciting a sudden increase of the energy-expending sympathetic component of the infant's autonomic nervous system (ANS); this results in significantly elevated heart rate, blood pressure, and respiration, the somatic expressions of a dysregulated psychobiological state of fear–terror. This active state of sympathetic hyperarousal is expressed in increased secretion of corticotropin releasing factor (CRF)—the brain's major stress hormone. CRF regulates sympathetic catecholamine activity, creating a hypermetabolic state in the developing brain.

But a second later forming reaction to relational trauma is dissociation in which the child disengages from stimuli in the external world—traumatized infants are observed to be "staring off into space with a glazed look". This parasympathetic dominant state of conservation withdrawal occurs in helpless and hopeless stressful situations in which the individual becomes inhibited and strives to avoid attention in order to become "unseen". The dissociative metabolic shutdown state is a primary regulatory process by which the stressed individual passively disengages in order to conserve energies, fosters survival by the risky posture of feigning death, and allows restitution of depleted resources by immobility. In this hypometabolic state, heart rate, blood pressure, and respiration are decreased while pain-numbing and pain-blunting endogenous opiates are elevated. This energy-conserving parasympathetic (vagal) mechanism mediates the "profound detachment" of dissociation. Q11

In fact there are two parasympathetic vagal systems in the brainstem medulla (Porges, 1997). The ventral vagal complex rapidly regulates cardiac output to foster fluid engagement and disengagement with the social environment, aspects of a secure attachment

bond of emotional communication. On the other hand, activity of the dorsal vagal complex is associated with intense emotional states and immobilization, and is responsible for the severe metabolic depression, hypoarousal, and pain blunting of dissociation. The traumatized infant's sudden state switch from sympathetic hyperarousal into parasympathetic dissociation is described by Porges (1997) as "the sudden and rapid transition from an unsuccessful strategy of struggling requiring massive sympathetic activation to the metabolically conservative immobilized state mimicking death associated with the dorsal vagal complex." Whereas the ventral vagal complex exhibits rapid and transitory activations, the dorsal vagal nucleus exhibits an involuntary and prolonged pattern of vagal outflow, creating lengthy "void" states associated with pathological dissociative detachment.

How are the dual traumatic contexts of hyperarousal and dissociative hypoarousal expressed behaviorally within the mother–infant dyad? Observational research demonstrates a link between frightening maternal behavior, dissociation, and disorganized infant attachment (Schuengel, Bakersmans-Kranenburg, & Van IJzendoorn, 1999). Hesse and Main (1999) observe the mother's frightening behavior: "in non-play contexts, stiff-legged 'stalking' of infant on all fours in a hunting posture; exposure of canine tooth accompanied by hissing; deep growls directed at infant." In recent work, Hesse and Main (2006) document that a fear alarm is triggered in the infant when the mother enters a dissociative freeze state: "Here the parent appears to have become completely unresponsive to, or even aware of, the external surround, including the physical and verbal behavior of their infant. . .[W]e observed one mother who remained seated in an immobilized and uncomfortable position with her hand in the air, blankly staring into space for 50 sec." Note the intergenerational transmission of not only relational trauma but the bottom-line defense against traumatic emotional experiences, dissociation.

Right Brain Pathological Dissociation and Self-Psychological Deficits

Workers in the field of developmental traumatology now assert that the overwhelming stress of maltreatment in childhood is associated with adverse influences on not just behavior but also on brain development (de Bellis *et al*., 1999). During the intergenerational transmission of attachment trauma, the infant is matching the rhythmic structures of the mother's dysregulated arousal states. This synchronization is registered in the firing patterns of the stress-sensitive corticolimbic regions of the right brain, dominant for coping with negative affects (Davidson *et al*., 1990). Describing the essential survival functions of this lateralized system, Schutz (2005) notes "The right hemisphere operates a distributed network for rapid responding to danger and other urgent problems. It preferentially processes environmental challenge, stress and pain and manages self-protective responses such as avoidance and escape." The right brain is fundamentally involved in an avoidant-defensive mechanism for coping with emotional stress, including the passive survival strategy of dissociation.

Current neurobiological data can be used to create models of the mechanism by which attachment trauma negatively impacts the right brain. Adamec and colleagues (2003) report experimental data that "implicate neuroplasticity in right hemispheric limbic circuitry in mediating long-lasting changes in negative affect following brief but severe stress." According to Gadea *et al*. (2005) mild to moderate negative affective experiences activate the right hemisphere, but an intense experience "might interfere with right hemisphere processing, with eventual damage if some critical point is reached." This damage is specifically hyperarousal-induced apoptotic cell death in the hypermetabolic right brain. Thus, via a switch into a hypoarousal, a hypometabolic state allows for cell survival at times of intense excitotoxic stress (Schore, 1997b, 2001, 2002c, 2003b).

Recall that right cortical areas and their connections with right subcortical structures are in a critical period of growth during early human development. The massive psychobiological stress associated with attachment trauma sets the stage for the characterological use of right brain pathological dissociation when encountering later stressors. Converging evidence indicates that early abuse negatively impacts limbic system maturation, producing enduring neurobiological alterations that underlie affective instability, inefficient stress tolerance, memory impairment, and dissociative disturbances. In this manner, traumatic stress in childhood leads to self-modulation of painful affect by directing attention away from internal emotional states (Lane *et al*., 1997). The right brain, dominant for attention (Raz, 2004) and pain processing (Symonds *et al*., 2006), thus generates dissociation, a defense by which intense negative affects associated with emotional pain are blocked from consciousness.

Congruent with developmental and clinical models, Spitzer *et al*. (2004) report a transcranial magnetic stimulation study of adults and conclude, "In dissociation-prone individuals, a trauma that is perceived and processed by the right hemisphere will lead to a 'disruption in the usually integrated functions of consciousness.'" In functional magnetic resonance imaging research, Lanius *et al*. (2005) show predominantly right hemispheric activation in psychiatric patients while they are dissociating and conclude that dissociation, an escape from the overwhelming emotions associated with the traumatic memory, can be interpreted as representing a nonverbal response to the traumatic memory.

These studies explore the evolution of a developmentally impaired regulatory system and provide evidence that prefrontal cortical and limbic areas of the right hemisphere are centrally involved in the deficits in mind and body that are associated with a pathological dissociative response (Schore, 2002c, in press). This right hemisphere, more so than the left, is densely reciprocally interconnected with emotion-processing limbic regions as well as with subcortical areas that generate both the arousal and autonomic bodily based aspect of emotions. Sympathetic nervous system activity is manifest in tight engagement with the external environment and high level of energy mobilization, while the parasympathetic component drives disengagement from the external environment and uses low levels of internal energy (Recordati, 2003). These ANS components are uncoupled in relational trauma.

In a recent psychoanalytic formulation that echoes Kohut's "uncurbed spreading of anxiety or other emotions", Bromberg (2006) links right brain trauma to autonomic hyperarousal, "a chaotic and terrifying flooding of affect that can threaten to overwhelm sanity and imperil psychological survival." Dissociation is then automatically and immediately triggered as the fundamental defense to the arousal dysregulation of overwhelming affective states. And in the psychiatric literature, Nijenhuis[67] asserts that "somatoform dissociation" is an outcome of early onset traumatization expressed as a lack of integration of sensorimotor experiences, reactions, and functions of the individual's self-representation. Dissociatively detached individuals are not only detached from the environment but also from the self—their body, their actions, and their sense of identity (Allen, Console, & Lewis, 1999). Crucian *et al*. (2000) describe "a dissociation between the emotional evaluation of an event and the physiological reaction to that event, with the process being dependent on intact right hemisphere function."

Pathological dissociation thus reflects the chronic disintegration of a right brain system and a resultant adaptive failure of its capacity to rapidly and nonconsciously detect, process, and cope with unbearable emotional information and overwhelming survival threat. A poorly developed right cortical–subcortical implicit self-system is inefficient at recognizing and processing external stimuli (exteroceptive information coming from the relational environment) and on a moment-to-moment basis

integrating them with internal stimuli (interoceptive information from the body). This too frequent failure of integration of the higher right hemisphere with the lower right brain induces an instant collapse of both subjectivity and intersubjectivity, even at lower levels of interpersonal stress.

In summary, the developing brain imprints not only the overwhelming affective states that are at the core of attachment trauma but also the primitive defense used against these affects—the regulatory strategy of dissociation. It is now established that maternal care influences both the infant's reactivity (Menard, Champagne, & Meaney, 2004) and the transmission of individual differences in defensive responses (Parent *et al*., 2005). A large body of psychiatric, psychological, and neurological studies supports the link between childhood trauma and pathological dissociation (e.g., Draijer & Langeland, 1999; Macfie, Cicchetti, & Toth, 2001; Merckelbach & Muris, 2001; Dikel, Fennell, & Gilmore, 2003; Liotti, 2004).

Conclusion: Rapprochement between Psychoanalysis and Neuroscience

Researchers now conclude that, because of dissociation, elements of a trauma are not integrated into a unitary whole or an integrated sense of self (Van der Kolk *et al*., 1996). The symptomatology of pathological dissociation, or what Kohut described as "walling oneself off" from intense, traumatizing experience, thus represents a structural impairment and deficiency of the right brain, the locus of a "corporeal image of self" (Devinsky, 2000), affective empathy (Schore, 1994; Decety & Chaminade, 2003), and a "sense of humanness" (Mendez & Lim, 2004). Recall Kohut's speculation that early trauma acts as a growth-inhibiting environment for the developing self, one which generates "an impoverished psychic organization", a deficit in being empathic, and an inability "to be fully human". The self-depleting structure-altering cost of characterological dissociation is thus a central psychopathogenetic concept of both self psychology and neuroscience.

A central tenet of Kohut's model of psychopathogenesis is that the long-term effects of chronic maternal failure to provide growth-facilitating selfobject regulatory functions is the genesis of a "developmental arrest". Recall the self-psychological proposal that, because of early trauma, the developing selfobject regulatory function is deficient or "damaged". This development impairment can now be identified as a maturational failure of the right brain affect regulatory system. A large body of clinical observations and psychiatric research strongly suggests that the most significant consequence of early relational trauma is the child's failure to develop the capacity to self-regulate the intensity and duration of emotional states. The principle that maltreatment in childhood is associated with adverse influences on brain development specifically refers to an impairment of a higher circuit of emotion regulation on the right side of the brain.

At the beginning of this chapter I stated that a central area of inquiry of Kohut's psychoanalytic theory was the problem of how the therapeutic relationship scaffolds the "restoration of self". Early relational trauma and the characterological use of the right brain strategy of pathological dissociation are common elements of the histories of severe self-pathologies of personality disorders, a clinical population of increasing interest to self psychology and psychotherapists in general. A large multicenter study of adult patients with a history of early childhood trauma reports that psychotherapy is an essential element of the treatment of such cases and indeed is superior to pharmacotherapy as an effective intervention (Nemeroff *et al*., 2003).

Any psychotherapeutic intervention with these patients must treat not only traumatic symptoms but also the dissociative defense (Bromberg, 2006). Spitzer's (2007) research shows that higher levels of dissociation predict Q12

poorer outcome in patients in psychodynamic psychotherapy. These authors conclude dissociative patients have an insecure attachment pattern negatively affecting the therapeutic relationship and that they dissociate as a response to negative emotions arising in psychotherapy. Clinical authors now suggest that the treatment of traumatic dissociation is essential to effective psychotherapy with these patients (Spiegel, 2006; Schore, 2007).

The self-psychological focus on selfobject regulation clearly suggests that deficits and defenses of affect and affect regulation are a primary focus of the treatment of these early forming psychopathologies. With respect to the mechanism of change, Kohut (1984) postulated "psychoanalysis cures by the laying down of psychological structure." This structure is essentially in the right brain and its limbic emotion-regulating circuits. Studies indicate that emotional self-regulatory processes constitute the core of psychotherapeutic approaches (Beauregard, Levesque, & Bourgouin, 2001), that the development of self-regulation is open to change in adult life, providing a basis for what is attempted in therapy (Posner & Rothbart, 1998), and that psychotherapy affects clinical recovery by modulating limbic and cortical regions (Goldapple *et al*., 2004).

In addition to a more complex understanding of the psychotherapy change process an integration of neuroscience and self psychology has another important potential benefit. Psychoanalysis, neuroscience, and child psychiatry all share the well-established psychopathogenetic principle that maltreatment in childhood is associated with adverse influences on the infant's brain/mind/body and thereby alters the developmental trajectory of the self over the ensuing life span. Interdisciplinary research that incorporates psychoanalytic self psychology with the developmental and biological sciences can deepen our understanding of the underlying psychoneurobiological mechanisms by which early relational trauma mediates the unconscious intergenerational transmission of the deficits in affect regulation of early forming self-psychopathologies. This information may, in turn, generate more effective models of early intervention during the brain growth spurt and thereby contribute to the prevention of a broad range of psychiatric disorders.

Conflicts of Interest

The author declares no conflicts of interest.

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Queries

Q1 Author: Do you mean right part of the brain?
Q2 Author: 1997a or b? Please check.
Q3 Author: 1997a or b? Please check.
Q4 Author: 2003a or b? Please check.
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