ALLAN N. SCHORE

THE RIGHT BRAIN AS THE NEUROBIOLOGICAL SUBSTRATUM OF FREUD'S DYNAMIC UNCONCIOUS

The Psychoanalytic Century

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Over the last two decades, Freud's seminal model of a dynamic, continuously active unconscious mind has undergone a major transformation. This reformulation has been driven by not only clinical advances, but also by modifications of the theoretical underpinnings of the theory, especially updated concepts of development and structure. A rapidly evolving trend within psychoanalysis, "the science of unconscious processes" (Brenner 1980), is an increasing appreciation of the centrality of affective phenomena. Freud first delineated his ideas about affect in the "Project for a Scientific Psychology" (1895), a work that appeared at the dawn of psychoanalysis, in which he attempted to create a systematic model of the functioning of the human mind in terms of its underlying neurobiological mechanisms. Although he subsequently contended that the work of psychotherapy is always concerned with affect (1915a), it is only recently that an increased emphasis on affect is impacting clinical models.

During this same time period, a host of other scientific disciplines, liberated from the narrow behavioral model that dominated psychology for

much of the twentieth century, have begun to actively probe questions about the internal processes of mind that were for so long only addressed by psychoanalysis and deemed to be outside the realm of "scientific" analysis. In my ongoing work I document how a spectrum of sciences that border psychoanalysis are now researching the covert yet essential mechanisms that underlie overt behaviors, especially the role of emotional states. In a recent paper in the *Journal of the American Psychoanalytic Association,* "A Century after Freud's Project: Is a Rapprochement between Psychoanalysis and Neurobiology at Hand?," I have suggested that affect and its regulation are a potential point of convergence of psychoanalysis and neuroscience, and that the time is now right for the rapprochement Freud predicted (Schore 1997a).

Thus I, along with others who are calling for this integration, am quite pleased with the appearance of the new journal *Neuro-Psychoanalysis.* I am particularly honored to be part of an editorial board of distinguished psychoanalysts that includes Otto Kernberg and Arnold Modell, and neuroscientists such as Oliver Sacks, Eric Kandel, Karl Pribram, Joseph LeDoux, and Antonio Damasio. The first issue of the journal is devoted to Freud's theory of affect in the light of contemporary neuroscience, and in this chapter I want to offer some thoughts that are outlined in a paper I have contributed to the premier issue (Schore 1999).

In the journal I suggest that a common ground of both psychoanalysis

and neuroscience lies in a more detailed charting of the unique structure-function relationships of the emotion-processing right brain, which Ornstein (1997) calls "the right mind." Psychoanalysis has been interested in the right hemisphere since the split-brain studies of the 1970s, when a number of psychoanalytic investigators began to map out its preeminent role in unconscious processes (Galin 1974, Hoppe 1977, McLaughlin 1978). I propose that Freud's affect theory describes a structural system, associated with unconscious primary process affect-laden cognition and regulated by the pleasure-unpleasure principle, which is organized in the right brain. Knowledge of this right brain system offers us a chance to more deeply understand not just the contents of the unconscious, but its origin, structure, and dynamics.

In the following I will briefly evaluate Freud's affect theory in light of contemporary neuroscience. Then I will offer a developmental perspective of affective phenomena, and finally outline a dynamic systems-theory perspective of emotional processes.

FREUD'S AFFECT THEORY IN LIGHT OF CONTEMPORARY NEUROSCIENCE

Basic Emotions

Freud's earliest ideas about affect were first presented in the "Project," a

document that bridged his early career as a neurologist and later career as a psychologist. Throughout his subsequent writings he held that affects are "for the most part innately pre-wired, although some basic emotions are apparently forged during early development by momentous biological events of universal significance," and that in later life they represent "reproductions of very early experiences of vital importance" (Freud 1926). There is now an intense interest in "biologically primitive emotions," which are evolutionarily very old, appear early in development, and are facially expressed (Johnson and Multhaup 1992). The early maturing right hemisphere is dominant for the first three years of life (Chiron et al. 1997), and it contains a basic primitive affect system (Gazzaniga 1985) that is involved in the modulation of "primary emotions" (Ross et al. 1994).

The Perceptual Aspect of Affects

Although Freud repudiated the Project, its central ideas appear in the seventh chapter *of The Interpretation of Dreams.* Here Freud (1900) proposed that the psychical apparatus is "turned towards the external world with its sense-organ of the Pcpt. [perceptual] systems," and through the regulatory mechanism of the "pleasure principle" value is assigned to mental performance. Freud thus highlighted the importance of affective appraisals of the personal significance of external stimuli to the generation of value and meaning. Current emotion researchers are emphasizing the importance of the

appraisal of facial expressions and the evaluative function of affects. The right hemisphere is dominant for the processing of facial information from infancy (Deruelle and de Schonen 1998) to adulthood (Kim et al. 1999), is faster than the left in performing valence-dependent, automatic, pre-attentive appraisals of emotional facial expressions (Pizzagalli et al. 1999) and is dominant for the recognition of the emotional prosody of language (Buchanan et al. 2000). Emotions involve rapid appraisals of events that are important to the individual (Frijda 1988) and represent reactions to fundamental relational meanings that have adaptive significance (Lazarus 1991).

From a neurobiological perspective LeDoux (1989) asserts that "the core of the emotional system" is a mechanism for computing the affective significance of stimuli. In a recent volume, I offer a chapter on the maturation of an evaluative system in the right cortex (Schore 1998). This lateralized system performs a "valence tagging" function (Watt 1998), in which perceptions receive a positive or negative affective charge, in accord with a calibration of degrees of pleasure-unpleasure. The essential roles of the right hemisphere in emotional perception (Adolphs et al. 1996, Anderson and Phelps 2000, Borod et al. 1998, Nakamura et al. 1999) and in the allocation of attention (Mesulam 1990, Sturm et al. 1999) are well documented.

The Expressive Aspect of Affects

In addition to a perceptual dimension, Freud (1915a) also intuited the "expressive" aspect of emotions, that the expression of emotions represented reflexive patterns of motor discharge. Current interdisciplinary research is demonstrating the dominance of the right hemisphere for facial displays of emotion (Borod et al. 1997, Dimberg and Petterson 2000) and spontaneous gestures (Blonder et al. 1995). In regard to Freud's ideas on the communication functions of affects, neuropsychological studies now report the preeminent role of the right hemisphere in emotional (Blonder et al. 1991), spontaneous (Buck, 1994), and nonverbal (Benowitz et al. 1983) communication. And with respect to his speculations on the memorial aspects of affect, there is now evidence for a right cerebral representation of affect-laden autobiographical information (Fink et al. 1996).

The Adaptive Aspect of Affects

The editors of *Neuro-Psychoanalysis,* Mark Solms and Ed Nersessian (1999), emphasize Freud's characterization of the adaptive function of affects: "According to Freud, the mental apparatus as a whole serves the biological purpose of meeting the imperative internal needs of the subject in a changing . . . environment" (p. 5). This essential psychobiological function is echoed by Damasio (1994) who concludes, "The overall function of the brain is to be well informed about what goes on in the rest of the body, the body proper; about what goes on in itself; and about the environment surrounding

the organism, so that suitable survivable accommodations can be achieved between the organism and the environment" (p. 90). But the two brain hemispheres have different patterns of cortical-subcortical connections, and therefore do not play an equal role in this function. The right hemisphere contains the most comprehensive and integrated map of the body state available to the brain (Damasio 1994) and is central to the control of vital functions supporting survival and enabling the organism to cope with stresses and challenges (Wittling and Schweiger 1993), and so its adaptive functions mediate the human stress response (Wittling 1997).

The characterization, in the neuroscience literature, of these adaptive right brain functions, performed at levels beneath awareness, is consonant with Winson's description, in current psychoanalytic writings, of revised models of the unconscious. Winson (1990) concludes, "Rather than being a cauldron of untamed passions and destructive wishes, I propose that the unconscious is a cohesive, continually active mental structure that takes note of life's experiences and reacts according to its scheme of interpretation" (p. 96).

Mind-Body Connections

From the beginning Freud posited that affective stimuli also arise "from within the organism and reaching the mind, as a measure of the demand

made upon the mind in consequence of its connection with the body" (1915b, p. 122). In Freud's most widely used definition, "drive is a concept at the frontier between the psychic and the somatic, an endogenous source of stimulation which impinges on the mind by virtue of the mind's connection with the body" (Greenberg and Mitchell 1983, p. 21). Damasio (1994) argues that emotions are "a powerful manifestation of drives and instincts." Although some psychoanalysts are now becoming interested in the body, much of the field is still mired in "Descartes' Error"—the separation of the operations of the mind from the structure and operation of a biological organism, the body (Damasio 1994)-Neuroscientists are now stressing that "the brain is but one component of the complex system that is the body. We take in information and interact with the world through our bodies, and our bodies change with —and in some cases change—cognitive and emotional processing" (Kutas and Federmeier 1998, p. 135).

Current "cognitive" neuroscience is less interested in the body that in the verbal and conscious capacities of the left hemisphere. But it is the right hemisphere that is more deeply connected into both the sympathetic and parasympathetic branches of the involuntary peripheral autonomic nervous system than the left (Spence et al. 1996), and thus dominant for "the metacontrol of fundamental physiological and endocrinological functions whose primary control centers are located in subcortical regions of the brain" (Wittling and Pfluger 1990, p. 260) and indeed for the corporeal and

emotional self (Devinsky 2000). Solms (1996) notes that the right hemisphere encodes representations "on the basis of perception derived initially from the bodily ego" (p. 347), clearly implying its dominant role in drive-related functions. Recent psychobiological and neurobiological studies thus strongly indicate that the concept of drive, devalued over the last twenty years, must be reintroduced—though reformulated—as a central construct of psychoanalytic theory.

Affect Regulation

Freud's special interest in the problem of regulation also first appears in the Project, a document which suggests "a model whereby excitation from various sources arising both from within and from outside the individual might be *regulated* by processes essentially within the individual" (Sander 1977, p. 14). And in this same farsighted opus Freud goes on to say that there is a close connection between affect and primary process, and that memories capable of generating affect are "tamed" (regulated) until the affect provides only a "signal."

In my ongoing work, I have detailed the development and unique functional capacities of the orbital prefrontal area of the cortex that regulates emotional and motivational states (Schore 1994, 1998). Due to its extensive reciprocal connections with energy controlling bio-aminergic nuclei in the

reticular formation and drive-inducing and drive-inhibiting systems in the hypothalamus, the orbitofrontal cortex is critical to the modulation of instinctual behavior (Starkstein and Robinson 1997), the experience of emotion (Baker et al. 1997), and the motivational control of goal-directed activities (Tremblay and Schultz 1999). Indeed, "the orbitofrontal cortex is involved in critical human functions, such as social adjustment and the control of mood, drive and responsibility, traits that are crucial in defining the 'personality' of an individual" (Cavada and Schultz 2000, p. 205). This prefrontal cortex, situated at the apogee of the "rostral limbic system," a hierarchical sequence of interconnected limbic areas in orbitofrontal cortex, insular cortex, anterior cingulate, and amygdala (Schore 1997b, 2000c, 2001a), is expanded in the right hemisphere (Falk et al. 1990). This hemisphere, more so than the left, is densely reciprocally interconnected with limbic regions (Tucker 1992), and therefore contains the major circuitry of emotion regulation (Porges et al. 1994). Furthermore, the orbitofrontal system matures at the end of a right hemisphere growth spurt in late infancy, and is centrally involved in attachment behavior (Schore 1994, 1996, 2000a,b, 2001a,c).

A DEVELOPMENTAL PERSPECTIVE OF AFFECTIVE PHENOMENA

In a continuation of Freud's principle of the primacy of early experience, recent developmental studies on the centrality of the attachment relationship

have been a major contributor to the current emphasis on affect within psychoanalysis. Early attachment is the "momentous biological event of universal significance" that Freud alluded to, and although for much of his career he seemed ambivalent about the role of maternal influences in earliest development, in his very last work he stated, in a definitive fashion, that the mother-infant relationship "is unique, without parallel, established unalterably for a whole lifetime as the first and strongest love-object and the prototype of all later love-relations" (Freud 1940). This fundamental ontogenetic principle was subsequently explored by a number of developmental psychoanalysts, most importantly in John Bowlby's attachment theory, a point of convergence of psychoanalysis and behavioral biology. In a departure from the classical Freudian developmental model, contemporary psychoanalysis now views these "vital" attachment experiences of the first two years as more central to personality formation than the later occurring oedipal events of the third and fourth year.

My own work in this area (Schore 1994, 1996, 1997b, 1998, 2001 a, b) has focused on the reciprocal affective transactions within the mother-infant dyadic system—in these face-to-face (Feldman et al. 1999) emotional communications the mother is essentially regulating the infant's psychobiological states. The attachment relationship is thus a regulator of arousal, and attachment is, in essence, the dyadic regulation of emotion (Sroufe 1996). But even more, these interactive affect regulating events act as

a mechanism for the "social construction of the human brain" (Eisenberg 1995). Trevarthen (1993) concludes that "the affective regulations of brain growth" are embedded in the context of an intimate relationship, and that they promote the development of cerebral circuits. This interactive mechanism requires older brains to engage with mental states of awareness, emotion, and interest in younger brains, and involves a coordination between the motivations of the infant and the subjective feelings of adults. In this manner, "the intrinsic regulators of human brain growth in a child are specifically adapted to be coupled, by emotional communication, to the regulators of adult brains" (Trevarthen 1990, p. 357).

I have offered evidence which suggests that attachment transactions represent right hemisphere-to-right hemisphere affective transactions between mother and infant (Schore 1994, 1996, 1997b, 2000b). These affective communications of facial expressions, prosody, and gestures are thus central to the experience-dependent maturation of the infant's early maturing right brain. Confirming this model, Ryan et al. (1997), using EEG and neuroimaging data, now propose: "The positive emotional exchange resulting from autonomy-supportive parenting involves participation of right hemispheric cortical and subcortical systems that participate in global, tonic emotional modulation" (p. 719).

The emotional interactions of early life thus directly influence the

organization of brain systems that process affect. In modeling the developmental neurobiology of attachment I have proposed that the attachment experiences of infancy are stored in the early maturing right hemisphere, and that for the rest of the lifespan unconscious working models of the attachment relationship encode, in implicit memory, strategies of affect regulation for coping with stress, especially interpersonal stress (Schore 1994, 2000b, 2001a,b,d). These internal representations are accessed as guides for future interactions, and the term "working" refers to the individual's unconscious use of them to interpret and act on new experiences.

This psycho-neurobiological mechanism mediates the internalization of the attachment relationship and the mother's regulatory functions. A secure attachment relationship facilitates the emergence, at the end of the second year, of what Bowlby (1969) termed a control system in the cortex. I identify this as the orbitofrontal system which, via its control of the autonomic nervous system (Neafsey 1990), mediates the highest level of control of emotional behavior (Price et al. 1996), that is, affect regulation. This frontolimbic system comes to act in an executive function for the entire right brain, which is specialized for "inhibitory control" (Garavan et al. 1999).

As the "senior executive of the emotional brain" (Joseph 1996), its operations are essential to a number of adaptive intrapsychic and interpersonal functions: it appraises facial information (Scalaidhe et al. 1997),

operates by implicit processing (Rolls 1996), generates nonconscious biases that guide behavior before conscious knowledge does (Bechara et al. 1997), functions to correct responses as conditions change (Derryberry and Tucker 1992), processes feedback information (Elliott et al. 1997), and thereby monitors, adjusts, and corrects emotional responses (Rolls 1986), and modulates the motivational control of goal-directed behavior (Tremblay and Schultz 1999).

So after a rapid evaluation of an environmental stimulus, the orbitofrontal system monitors feedback about the current internal state in order to make assessments of coping resources, and it updates appropriate response outputs in order to make adaptive adjustments to particular environmental perturbations (Schore 1998, 2000b). In this manner, "the integrity of the orbitofrontal cortex is necessary for acquiring very specific forms of knowledge for regulating interpersonal and social behavior" (Dolan 1999, p. 928).

The functioning of the "self-correcting" orbitofrontal system is central to self-regulation, the ability to flexibly regulate emotional states through interactions with other humans—interactive regulation in interconnected contexts via a two-person psychology, and without other humans, and autoregulation in autonomous contexts via a one-person psychology. The adaptive capacity to shift between these dual regulatory modes, depending

upon the social context, emerges out of a history of secure attachment interactions of a maturing biological organism and an early attuned social environment.

THE RELEVANCE OF NEUROBIOLOGICAL AND PSYCHOBIOLOGICAL RESEARCH ON EMOTION FOR CLINICAL PSYCHOANALYSIS

These neurobiological data on affective structure-function relationships have implications for clinical psychoanalysis. In current treatment models, affects, including unconscious affects, are both "the center of empathic communication" and the "primary data," and "the regulation of conscious and unconscious feelings is placed in the center of the clinical stage" (Sandler and Sandler 1978). The direct relevance of studies of emotional development to the psychotherapeutic process derives from the commonality of interactive emotion-transacting mechanisms in the caregiver-infant relationship and in the therapist-patient relationship. In the current neurobiological literature, the right hemisphere is dominant for "subjective emotional experiences" (Wittling and Roschmann 1993). The interactive "transfer of affect" between the right brains of the members of the mother-infant and therapeutic dyads is thus best described as "inter-subjectivity," a finding consonant with recent psychoanalytic "inter-subjective" models of the mind (Stolorow and Atwood 1992). Emotions, by definition, involve subjective states, and studies of the right hemisphere are thus detailing the neurobiology of subjectivity.

Transference-countertransference interactions, occurring at levels beneath awareness in both patient and therapist, represent rapid right hemisphere-to-right hemisphere nonverbal affective transactions (Schore 1994, 1997c, 2001c, in press a). These rapid expressions of the emotional right brain suggest that the emotional tone of voice, small movements of facial muscles, spontaneous gestures, and gaze aversions may be a better reflection of a person's affective state than his or her verbalizations (Panksepp 1999, Schore 1994, 2001c, in press a). In contemporary clinical models, perhaps the most important advances in this realm have come from those working in the "nonverbal real of psychoanalysis" (i.e., Jacobs 1994, Schwaber 1995).

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, in press a, e). Marcus (1997) has recently written, "The analyst, by means of reverie and intuition, listens with the right brain directly to the analysand's right brain" (p. 238). This neurobiological perspective is consonant with Kantrowitz's (1999) emphasis of the centrality of "intense affective engagements" and conclusion that "it is in the realm of preconscious communication that the inter-wovenness of intrapsychic and interpersonal phenomena become most apparent" (p. 72).

Current psychobiological studies indicate that affects are not merely

byproducts of cognition—they have unique temporal and physiological characteristics that, more than thoughts, define our internal experience of self. Although facial emotions can be appraised by the right brain within thirty milliseconds, spontaneously expressed within seconds, and continue to amplify within less than a half-minute, it can take hours, or days, or even weeks or longer for certain personalities experiencing extremely intense negative emotion to get back to a "normal" state again. Working with very rapid affective phenomena in real time involves attention to a different time dimension than usual, a focus on interpersonal attachment and separations on a micro-temporal scale. This moment-to-moment tracking attends to the internal mechanism by which the patient regulates emotional distance. The emphasis is less on enduring traits and more on transient states, less on temporally distant and more on short-term, immediate motivational factors.

Furthermore, neurobiological studies now demonstrate the involvement of the right hemisphere in "implicit learning" (Hugdahl and "nonverbal processes" (Schore 1994). Such structure-function relationships may elucidate how alterations in what Stem and colleagues (1998) call nonverbal "implicit relational knowledge" are at the core of therapeutic change. In light of the central role of the limbic system in both attachment functions and in "the organization of new learning" (Mesulam 1998), the corrective emotional experience of psychotherapy, which can alter attachment patterns, must involve unconscious right brain limbic learning.

Integrated psychoanalytic-neurobiological conceptualizations of emotional development can thus generate clinically relevant, heuristic models of treatment. In recent writings Westen (1997) asserts that "The attempt to regulate affect—to minimize unpleasant feelings and to maximize pleasant ones—is the driving force in human motivation" (p. 542). Affect dysregulation, a fundamental mechanism of the right hemispheric (Cutting 1992) dysfunctions of all psychiatric disorders (Schore 1997b, Taylor et al. 1997, Wasserstein and Stefanos 2000, Weinberg 2000), is now a primary focus of updated clinical psychoanalytic models. Very recent interdisciplinary models clearly suggest that an essential function of psychoanalytic treatment is to complete interrupted developmental processes (Gedo 1979), that all forms of psychotherapy promote affect regulation (Bradley 2000), and that a critical role of the psychotherapist is to act as an affect regulator of the patient's dysregulated states and to provide a growth-facilitating environment for the patient's immature affect-regulating structures (see Schore 1994, 1997c, in press a).

In other words, dyadic affective transactions within the working alliance co-create an intersubjective context that allows for the structural expansion of the patient's orbitofrontal system and its cortical and subcortical connections. Orbitofrontal function is essential to not only affect regulation but also to the processing of cognitive-emotional interactions (Barbas 1995) and affect-related meanings (Teasdale et al. 1999). This "thinking part of the

emotional brain" (Goleman 1995) functions as an "internal reflecting and organizing agency" (Kaplan-Solms and Solms 1996), is involved in "emotion-relating learning" (Rolls 1994), and acts to "integrate and assign emotional-motivational significance to cognitive impressions; the association of emotion with ideas and thoughts" (Joseph 1996), a characterization of the psychoanalytic therapeutic process.

A recently published functional magnetic resonance imaging (fMRI) study (Hariri et al. 2000) provides evidence that higher regions of specifically the right prefrontal cortex attenuate emotional responses at the most basic levels in the brain, that such modulating processes are "fundamental to most modem psychotherapeutic methods" (p. 43), that this lateralized neocortical network is active in "modulating emotional experience through interpreting and labeling emotional expressions" (p. 47), and that "this form of modulation may be impaired in various emotional disorders and may provide the basis for therapies of these same disorders" (p. 48).

According to Emde (1990), the therapeutic context mobilizes in the patient a biologically prepared positive development thrust. The findings that the prefrontal limbic cortex, more than any other part of the cerebral cortex, retains the plastic capacities of early development (Barbas 1995) and that the right hemisphere cycles into growth phases throughout the lifespan (Thatcher 1994) allows for the possibility of changes in "mind and brain"

(Gabbard 1994) in psychotherapy. Updated, psycho-biologically oriented psychoanalytic treatment models may potentiate what Kandel (1998), in a clarion call for a paradigm shift in psychiatry, describes as "biology and the possibility of a renaissance of psychoanalytic thought."

A DYNAMIC SYSTEMS-THEORY PERSPECTIVE OF EMOTIONAL PROCESSES

I would also like to suggest that the psychobiological realm of affective phenomena represents not only a convergence point of psychoanalysis with neuroscience, but also with the trans-scientific perspective of nonlinear dynamic systems theory (e.g., Prigogine and Stengers 1984, Gleik 1987, Kaufmann 1993). The causal variables involved in affect and its regulation are notoriously dynamic; they may change rapidly over time in intensity and frequency in a nonlinear pattern. In a recent work Taylor and colleagues (1997) assert that ". . . linear models may be inappropriate for the study of affect regulation and state transitions. . . . [T]he study of affect regulation may be improved by utilizing concepts and ideas from chaos theory and non-linear dynamical modelling" (p. 270).

Nonlinear dynamic systems theory, which the Scharffs (1998) and others are now delivering into psychoanalysis, models the mechanism of self-organization, of how complex systems that undergo discontinuous changes come to produce both emergent new forms yet retain continuity. A central

assumption of this theory is that energy flows are required for self-organizing processes. In a recent article on the self-organization of developmental paths, Lewis (1995) asks, "What is the best analogy for energy in psychological systems?" He points out that the energy flow through for self-organization has been conceived of as "information," an idea that fits well with Harold's (1986) formulation that information is a special kind of energy required for the work of establishing biological order. He then goes on to argue that information can be defined subjectively as that which is relevant: to an individual's goals or needs, an idea which echoes recent concepts of emotion as adaptive functions that guide attention to the most relevant aspects of the environment, and of emotional appraisals that monitor and interpret events in order to determine their significance to the self. Lewis concludes that there is no better marker of such information than the emotion that accompanies it, that emotions amplify fluctuations to act in self-organization, and that the processing of relevant information in the presence of emotion may be analogous to the flow through of energy in a state of disequilibrium. Stability is a property of interpersonal attractors that maintain their organization by perpetuating equilibrium as well as resolving emotional disequilibrium.

A central tenet of dynamic systems theory holds that at particular critical moments, a flow of energy allows the components of a self-organizing system to become increasingly interconnected, and in this manner organismic form is constructed in developmental processes. As the patterns of relations

among the components of a self-organizing system become increasingly interconnected and well ordered, it is more capable of maintaining a coherence of organization in relation to variations in the environment. In previous work I have proposed that emotional transactions involving synchronized ordered patterns of energy transmissions (directed flows of energy) represent the fundamental core of the attachment dynamic (Schore 1994, 2000c).

More specifically, in right brain-to-right brain emotion-transacting attachment communications, patterns of information emanating from the caregiver's face, especially of low visual and auditory frequencies (Ornstein 1997), trigger metabolic energy shifts in the infant. The caregiver is thus modulating changes in the child's energetic state, since arousal levels are known to be associated with changes in metabolic energy. A recent article in *Science* indicates that "mothers invest extra energy in their young to promote larger brains" (Gibbons 1998, p. 1347). Furthermore, these regulated emotional exchanges trigger synchronized energy shifts in the infant's developing right brain, and these allow for a coherence of activity within its cortical and subcortical levels and the organization of the emotion-processing right brain into a self-regulating "integrated whole." In this manner, "the self-organization of the developing brain occurs in the context of a relationship with another self, another brain" (Schore 1997b, 2000c).

This description of how early affective experience creates energy that, in turn, facilitates the organization of developing internal structure directly applies to psychoanalytic energetic metapsychological constructs, a body of knowledge that has been ignored or devalued over the last forty years. In very recent psychoanalytic writings, Schulman (1999) argues that energic "binding" is viewed as energy tied up in structures, and is therefore needed for "the transformation and structuralization of the ego" [and superego]. Energic concepts, he states, become the means for "new psychological developments" such as "ordered thoughts, goal-directed behavior, and controlled affect" (p. 480). Freud's energy models, long considered obsolete, need to be modernized and reintegrated into psychoanalysis (Schore 1994, 1997a, Solms 1996, Shevrin 1997).

Indeed, throughout the lifespan, energy shifts are the most basic and fundamental features of emotion, discontinuous states are experienced as affect responses, and nonlinear psychic bifurcations are manifest as rapid affective shifts. Such state transitions result from the activation of synchronized bio-energetic processes in central nervous system limbic circuits that are associated with concomitant homeostatic adjustments in the autonomic nervous system's energy-expending sympathetic and energy-conserving parasympathetic branches. Emotional mind-body states thus reflect the nonlinear pulsing of energy flows between the components of a self-organizing, dynamic, right-lateralized mind-body system. Furthermore,

the fact that affectively-charged psychobiological states are known to be a product of the balance between energy-expending and energy-conserving components of the autonomic nervous system may be specifically relevant to Freud's emphasis on a dynamic conception of forces in the mind that work together or against one another in order to strive toward a goal.

A cardinal tenet of dynamic theory is that the nonlinear self-acts iteratively, so that minor changes, occurring at the right moment, can be amplified in the system, launching it into a qualitatively different state. An example of this principle is found within the intersubjective field co-constructed by the patient and therapist. According to Kohut (1971) the empathically immersed clinician is attuned to the continuous flow and shifts in the patient's feelings and experiences.

The empathic clinician's right orbitofrontal cortex, a preconscious (Frank 1950) intrapsychic system activated by affective shifts and responsive to fluctuations in the emotional significance of stimuli (Dias et al. 1996), is responsible for his or her "oscillating attentive-ness" (Schwaber 1995) to "barely perceptible cues that signal a change in state" in both patient and therapist (Sander 1992), and to "nonverbal behaviors and shifts in affects" (McLaughlin 1996). In line with the principle that affect acts as an "analog amplifier" that extends the duration of whatever activates it (Tomkins 1984), the clinician's resonance with the patient's psychobiological states allows for

an amplification of affect within the intersubjective field.

This interactive regulation of the patient's state enables him or her to now begin to verbally label the affective experience. In a "genuine dialogue" with the therapist, the patient raises to an inner word and then into a spoken word what he needs to say at a particular moment but does not yet possess as speech. But the patient must experience this verbal description of how an internal state is heard and felt by an empathic other. This, in turn, facilitates the "evolution of affects from their early form, in which they are experienced as bodily sensations, into subjective states that can gradually be verbally articulated" (Stolorow and Atwood 1992, p. 42).

The patient's affectively charged but now regulated right brain experience can then be communicated to the left brain for further processing. This effect, which must follow a right-brain-then-left-brain temporal sequence, allows for the development of linguistic symbols to represent the meaning of an experience, *while one is feeling and perceiving the emotion generated by the experience.* The objective left hemisphere can now co-process subjective right brain communications, and this allows for a linkage of the nonverbal and verbal representational domains.

In addition, I have recently argued that as opposed to the verbal left hemisphere's "linear" consecutive analysis of information, the processing

style of the visuospatial right hemisphere is best described as "nonlinear," based on multiple converging determinants rather than on a single causal chain (Schore 1997b, 2000c). According to Ramachandran and colleagues (1996), the cognitive style of the right hemisphere shows a highly sensitive dependence to initial conditions and perturbations, a fundamental property of chaotic systems. This minor hemisphere utilizes image thinking, a holistic, synthetic strategy that is adaptive when information is "complex, internally contradictory and basically irreducible to an unambiguous context" (Rotenberg 1994, p. 489). These characterizations also apply to primary process cognition, a right hemispheric function (Galin 1974, Joseph 1996) of the unconscious mind.

Current neurobiological studies are revealing greater right hemispheric involvement in the unconscious processing of emotion-evoking stimuli (Wexler et al. 1992) and conditioned autonomic responses after subliminal presentations of faces to the right and not left cortex (Johnsen and Hugdahl 1991). Most intriguingly, a very recent positron emission tomographic (PET) study demonstrates that unconscious processing of emotional stimuli is specifically associated with activation of the right and not left hemisphere (Morris et al., 1998), supporting the idea that "the left side is involved with conscious response and the right with the unconscious mind" (Mlot 1998, p. 1006). These, and the aforementioned studies, strongly suggest that the emotion-processing right mind (Ornstein 1997) is the neurobiological

substrate of Freud's unconscious.

Freud's concept of the dynamic unconscious is usually interpreted to refer to the self-regulatory capacities of an unconscious system, which operates via the process of repression in order to bar access of sexual and aggressive wishes into consciousness. This characterization describes the left hemispheric horizontal inhibition of right hemispheric cognitive-emotional representations. The current expanding body of knowledge of the right hemisphere suggests a major alteration in the conceptualization of the Freudian unconscious, the internal structural system that processes information at nonconscious levels.

It is now established that "operation of the right prefrontal cortex is integral to autonomous regulation" (Ryan et al. 1997, p. 718), that the right hemisphere is dominant for the processing of "self-related material" (Keenan et al. 1999, 2001), and that the self-concept is represented in right frontal areas (Craik et al. 1999). Freud's seminal model of a dynamic, continuously active unconscious mind thus describes the moment-to-moment operations of a hierarchical, self-organizing regulatory system that is located in the right brain. The center of psychic life thus shifts from Freud's *ego,* which he located in the "speech-area on the left-hand side" (1923) and the posterior areas of the verbal left hemisphere, to the highest levels of the nonverbal right hemisphere, the locus of the bodily-based *self*-system (Craik et al. 1999,

Devinsky 2000, Mesulam and Geschwind 1978, Schore 1994) and the unconscious mind (Joseph 1992).

Twenty-five years after the Project, Freud (1920) described the unconscious as "a special realm, with its own desires and modes of expression and peculiar mental mechanisms not elsewhere operative." In this same work he proclaimed *"the unconscious is the infantile mental life*" [italics in original]. Further studies of this early-developing right brain, unconscious, affectively charged, dynamic mind-body system are now called for.

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