

## A NEUROSCIENCE DIGEST

## PART II

## AFFECTIVE AND DEVELOPMENTAL NEUROSCIENCE

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*This is the second of a three part review. In our last issue, **Part I: Understanding the Mind-Brain and Nervous System**, we presented a primer and an orientation to current foundational books that map the essential principles of neuroscience. In this issue, **Part II: Affective and Developmental Neuroscience**, we look at Jaak Panksepp and Antonio Damasio, at Allan Schore's regulation theory, and Daniel Siegel's interpersonal neurobiology. Finally, in our next issue, **Part III: Neuroscience in Somatic Clinical Application** we will explore neuroscience in relation to somatic psychotherapy.*

This review gives a general overview of the contributions of four important thinkers who have each published landmark books: Jaak Panksepp, Antonio Damasio, Allan Schore, and Daniel Siegel. These authors are remarkable because of the breath and detail of their knowledge which allows them to make important creative interdisciplinary bridges between neurobiological, behavioral, affective, and cognitive concepts.

The advent of modern neuroscience highlights the inquiry into how mind is materially supported by and subject to natural law. An interesting dilemma has existed between the materialist and humanistic worldviews. According to the materialistic worldview, the evolution of life on earth is solely the result of complex chemical reactions. In the humanistic worldview, our ability to think about material reality transcends that reality and the cultural matrix of the arts and sciences forms an invisible cosmology which affirms the priority of mind over nature. In the movement towards the conciliation of this two-fold mystery, affective neuroscience seeks to understand how environmentally acquired internal representations in the present world interact with genetically dictated neurodynamics built out of the evolutionary experiences of worlds past.

It is only recently, specifically in the past two decades, that the development of new research tools has led to techniques that open the way to link specific behaviors and their corresponding brain activity. In an endeavor to map the neural architecture that supports consciousness, several approaches have been developed: 1) 3-D reconstructions of a living person's brain that permits the observation of the effect of brain lesions on behavioral or cognitive tasks; 2) positron emission scan (PET) and functional magnetic resonance imaging (fMRI) that reveal increased or decreased energy-consuming activation in the neurons allowing new levels of hypothesis and validity assessment; 3) measurements of the changes in electrical

conductance response and changes in electric potentials and related magnetic fields in the skin and scalp; 4) study of the molecular events within individual nerve cells and the relation of those events to the composition and action of specific genes. In the developmental arena, increasing numbers of studies concurrently measure brain, behavioral, and bodily changes in both members of the infant-mother dyad. Researchers can now literally observe brain-to-brain interactions between a mother and her infant; they can look at the synchronized changes between them as they are processing emotional states with each other and take measures on both of them to study these changes at the autonomic level. These exciting new technological advances provide data for building progressively more precise models of the brain and of the brain in relationship.

According to Panksepp, the central tenet of affective neuroscience is that emotional processes arise from neurological events to provide a sense of internal values, causality, category, and classification upon which mammals and humans *alike* base their behavior. Core emotional states, which we experience as our deep instinctual nature, provide self-referential value-coding mechanisms that allow us to categorize events happening in the external world and organize our behavior. Panksepp suggests that the mediation and modulation of subjective feelings, which make up our self-representation systems, arise from underlying cognitive and emotional potentials based in material events at the neural level. It is by looking at the categories of emotive behaviors along with analyzing their movement in the brain circuitry from which they arise, that the affective and developmental neuroscientists are progressing in sorting out the various processes that make us who we are.

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## AFFECTIVE NEUROSCIENCE

*The living, beyond any word language and independent of it, has its own expressive language.*  
—Wilhelm Reich

**Affective Neuroscience** by Jaak Panksepp. Oxford University Press, 1998.

**The Feeling of What Happens** by Antonio Damasio. New York: Harcourt, 1999.

**Looking for Spinoza** by Antonio Damasio. New York: Harcourt, 2003.

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Jaak Panksepp and Antonio Damasio both write about affect as a central organizing process and both emphasize the centrality of the body and the fact that “our emotional feelings reflect our ability to subjectively experience certain states of the nervous system” (Panksepp 1998, p.9). Panksepp views the fundamentally affective nature of the human mind as comprised of basic, instinctual, and motivational operating systems anchored in a biological imperative. Damasio views affect as *the cognition of bodily states*—a feeling is not “an elusive mental quality...but rather the direct perception of a specific landscape: that of the body.”

### **Jaak Panksepp: Affective Neuroscience and the Foundations of Human and Animal Emotions**

*My personal conviction is that we shall really not understand the brain or the nature of consciousness until we begin to take emotional feelings more seriously, as internally experienced neuro-symbolic self-referenced representations of major evolutionary passages, in the animals that we study.*

—Jaak Panksepp

Steeped in ethology—the study of animal behaviour—neurobiologist and psychiatrist Jaak Panksepp’s stated goal is to “attempt to clarify the interrelations between brain and mind as expressed in the fundamental emotional processes that all mammals share.” Dedicating his book to the “new synthetic psychology” of the future, and aware that many generations of careful work are still needed before we have a true and lasting science of emotions, Panksepp aspires to provide a cohesive map to guide future navigations. A rich interdisciplinary thinker, he makes a parallel between the opening of commerce routes between Europe and the Far East a millennium ago, and the needs of our present state of fragmentary knowledge: the recently evolved rational and cultural mind (Europe) and the ancient networks of our brains (Far East) need trade routes to construct intellectual commerce and share in each other’s wealth.

*Affective Neuroscience*, which is probably the best introductory textbook to the field, builds jointly on ethology, evolutionary psychology, neuroscience, behaviorism, cognitive sciences, sociobiology, clinical psychology, and psychiatry. It is divided in three parts: 1) Part I sets the stage, covers conceptual background issues and provides a relatively user-friendly summary of neuroanatomy, neurophysiology, and neurochemistry; 2) Part II identifies the primitive basic emotional and motivational processes such as how sleep and dreaming organize emotionality in the brain, the reward and reinforcement self-stimulating systems which control foraging, seeking, and positive expectancies, and how the brain maintains certain consistencies such as energy and water through mechanisms of pleasure and aversion; 3) Part III offers perspectives on the more subtle social emotions, in particular the emotional cascade within the reproductive-development phase of the life-cycle, starting with sexuality, nurturance, separation distress, and play. As the book progresses, Panksepp approaches increasingly difficult subjects and culminates with the intricate matter of self and higher mental processes.

This book presents an original integrative form of psychobiology which, possible only because of the recent growth of neuroscience, appreciates how “our highest aspirations remain tethered to the values elaborated by ancient parts of our animal brain.” Throughout the book, he blends animal and human issues as a strategy towards new scientific insights, believing that it is more important to recognize our similarities with the animals than to pursue our differences. I am reminded in this of the Native Americans who have always felt a spiritual bond with the animals and looked to them for wisdom and insight, believing that every animal is a teacher, a respected equal whose unique traits provide a model for human behavior. Panksepp shows that in spite of a significantly more developed neo-cortex and the addition of language, social and cultural learning, human instinctual neural circuitry and neurochemistry closely

parallels that of mammals. It is, he believes, by understanding the neural basis of animal emotions that we come to clarify the primal sources of our own. According to Panksepp, the mammalian brain not only internally represents the outside world in symbolic codes based on its sensory-perceptual systems, but in addition, also has intrinsic *emotional operating systems* that govern psychobehavioral strategies for coping with the ever-present evolutionary challenges. He believes that it is in these ancient operating systems that emotions arise which are, in all probability, internally felt by animals in ways not so different from humans. Looking at underlying behaviors such as mating, nurturing, or defending territory, that do not require previous learning and evolved long before the emergence of the human neocortex, it becomes apparent that because of our extensive common evolutionary journey, we share with mammals many basic psychoneural processes. In spite of our aspirations to transcend our animal nature through our higher cortical abilities, Panksepp confirms that powerful animal forces survive beneath our cultural veneer. It is, he notes, this ancient animal heritage that makes us the intense, feeling creatures that we are.

### ***The varieties of emotional systems in the brain***

The prelinguistic processes that govern emotional organization make it difficult to find language to speak about emotions. In *Affective Neuroscience*, Panksepp explores the fundamental sources of our genetically ingrained affective potentials. In his attempt to discover how emotions are generated, Panksepp recognizes seven emotional operating systems and considers each system in depth, using excellent diagrams and research summaries to discuss implications and provisional conclusions. Panksepp's emotional operating systems can be divided into two sets: 1) First, a primordial set of three primitive emotions and motivations that mature soon after birth, are basic to survival, and are identified by the fact that localized brain stimulation consistently evokes these same emotional displays in experimental animals. These include a SEEKING system to oversee energetic search, investigation, and goal-directed behavior; a biting and affective attack RAGE system easily aroused by thwarting and frustrations; and a FEAR system of flight and escape behaviors designed to minimize the probability of bodily destruction. 2) Secondly, there is a more sophisticated special-purpose socioemotional set that depends on the creation and maintenance of social bonds: a distress vocalization and separation PANIC system which is especially important in the elaboration of social emotional processes related to attachment; a LUST system designed to mediate sexuality; a maternal CARE system that assures that the important events of birthing and the ensuing necessary nurturance are not left to chance or to the vagaries of individual learning; and a roughhousing PLAY system. The names of the systems are capitalized to distinguish their neuro-functional referent from ordinary usage. Separate chapters are devoted to the exploration of each of these systems. Panksepp regards these seven emotional operating systems, which come close to what we might call "instincts," as regulatory mechanisms emerging from the intrinsic potentials of the nervous system in order to coordinate brain organization and rapidly instigate effective survival behavior. Essentially "chaotic" in the mathematical sense of non-linear dynamics, he theorizes that the emotional operating systems may act as "strange attractors" that exert a "neurogravitational force" on the activities of the brain within the neural networks. Of particular interest to somatically-based psychotherapists is the fact that

these emotional operating systems have prototypical facial expressions, bodily postures, gestures, and behavioral actions. This supports the body-centered clinical stance that the embodiment of a feeling can be accomplished by encouraging a client to enter the world of gesture, breath and movement, to fully take a stance, or explore a strong facial expression. While some of the emotional operating systems Panksepp describes are predictable, others radically re-formulate our established categories of affect leading to surprising implications.

***Engagement and excitement: the SEEKING system***

To give a detailed example of a primitive system, the SEEKING system is seen to govern interest, curiosity and the search for meaning and is propelled by states of curiosity, excitement and pursuit. Its prototype is foraging, the ability to eagerly anticipate what we need for survival like the search for such resources as food, shelter, or a mate. In animals, sniffing and persistent forward locomotion are indicators that the SEEKING system is active. In humans, seeking behaviour can range from attempting to satisfy hunger by looking in the refrigerator to addressing abstract needs such as the search for meaning as seen in questions like: “Where are we ‘going’?” Critical to adaptive survival, the SEEKING system energizes and invigorates an individual’s relation to the environment by providing the motivational force to move forward, to follow the scent in the quest for new resources. A good example of a modern application of the SEEKING system is psychotherapy which focuses on learning, searching for meaning, and making new connections.

The “power switch” that turns on the SEEKING system is dopamine. Responsible for our sense of self-empowerment, dopamine is the visionary chemical behind the high that accompanies the idea of starting over, opening us to the optimistic positive thinking necessary for constructive change. Linked to the pleasure of discovery and the drive to formulate, dopamine has a similar chemistry to cocaine and a similar effect: it triggers states of high arousal and focus. Dopamine appears to be discharged during REM sleep, dream states, and phenomena such as the startle reflex which is linked to the physiology of orientation. Interestingly, Freud, who used cocaine, explored dreams and was driven to investigate the psyche, both indications of an activated SEEKING system.

There is a delicate balance to strike between this system’s assets and its possible imbalances. Dysregulation of the SEEKING system can lead to manic and unstable states of mind. For example, excessive dopamine activity can cause paranoid schizophrenia while anti-psychotic drugs, which reduce dopamine activity at specific receptors sites, inhibit not only the negative but also the positive SEEKING behaviours. Without this system, we experience lack of hope, we feel flat, or fixed in a never-ending process of mourning. Over-activation of the SEEKING system can become a seductive trap: Dreaming, investigating, pioneering, journeying are activities that generate high levels of pleasure and satisfaction that increase the sense of autonomy but can also work in the service of denial by turning attention away from what is painful and lead away from social contact.

***The construction of social bonds: the PANIC system***

We are a long way from reptilian times when young were left to fend for themselves. At present, Panksepp writes, we live in a child-oriented era. Research tells us that children who come from loving and supportive families, and who are given age appropriate educational challenges, operate from a “secure base” that allows for intimacy and trust and gives a child the opportunity to become a vital, self-regulating adult. “But what is” Panksepp asks, “the nature of this loving and supportive “secure base” that psychologists speak of?” It is a recent discovery that the brain contains emotional systems to directly mediate social bonds and social feelings. The importance of social bonding became apparent with the studies by René Spitz in orphanages demonstrating that babies who received no caring human contact often died prematurely. Friendship, family attachment, or romantic relationships are manifestations of social bonding exhibiting an emotional span ranging from intense attraction to separation-induced despair and even death.

How attachment needs arise in the brain is emerging from the analysis of one particular behavioral measure, the vocal “crying” triggered by social isolation in young mammals. Also labelled “isolation calls” or “distress vocalizations,” there is an intrinsic neural system in the brain, which Panksepp calls *the PANIC system*, that mediates this strong emotional response. Along with separation induced distress vocalizations, the behavioral and physiological changes exhibited by all young mammals after a short period of separation include decreases in body temperature, in sleep, and in growth-hormone secretion, as well as increases in brain arousal, behavioral reactivity, sucking tendencies, and corticosterone secretions. Distress vocalizations are highly arousing and powerfully motivating to the caregiving drive of the maternal CARE system. If no bond exists, the sound of distress calls can be perceived by a parent as an irritation that can lead to child abuse.

It is theorized that the arousal of PANIC circuits is one of the major sources that leads to social bonding; when PANIC circuits are aroused, animals seek reunion with those who help create a feeling of a “secure neurochemical base.” Social bonding, Panksepp writes, goes hand in hand with the experience of loneliness, grief, and other feelings of social loss: “To be alone and lonely, to be without nurturance or a consistent source of erotic gratification, are among the worst and most commonplace emotional pains humans must endure”(p. 263). It seems that the PANIC system is closely intermeshed with the attachment system and that love is in large part the neurochemically based positive feeling that negates loss, aloneness, and loneliness. Panksepp amplifies this fact by indicating that “all neurochemistries that normally inhibit separation distress may also promote bonding.” The research highlights the primal biological nature of certain forms of love and friendship.

In a remarkably similar outcome across studied species, the PANIC system arises from the mid-brain, in an area very close to where physical pain is generated; it seems to have evolved from pain centres and establishes that separation distress is related to perceptions of pain. Brain chemistries activated by caring

and supportive social interaction include neuropeptides such as oxytocin and prolactin, as well as endogenous opioids such as endorphins. The fact that touch is an important factor in the release of opioids is abundantly confirmed. One of the most powerful sensory signals of care is direct contact, and “contact comfort” appears to activate endogenous opioid systems that reinforce the social bond. Panksepp notes that “a substantial amount of social motivation emerges from the pleasures of touch, and the pleasure of play is strongly dependent on the sensation of touch.” Animals stop crying rapidly when gently touched and eye closure and settling down behaviours are common responses to being held. Interestingly, opioids mimic the action of heroin in quelling feelings of social isolation and it appears that nicotine, antidepressants, minor tranquilizers, and some sedatives can relieve separation distress.

Chronic arousal of the PANIC systems has long-term consequences: panic attacks, autism, despair, depression, seeking out any comfort that can be found, poor or abusive mothering, lifelong problems in social adjustment. Milder forms of separation distress can lead to social phobias such as chronic feelings of insecurity when interacting with others. Depression is seen to be the result of an inhibited despair following a period of intense vocalization; to optimise chances for survival, and to conserve fast depleting reserves, a lost offspring’s silent despair prevents the helpless organism from wandering further from its source of safety. Clearly, all mammals need close interaction with others to maintain emotional equilibrium. In sum, Panksepp theorizes, “social bonding ultimately involves the ability of young organisms to experience separation distress when isolated from social support systems and to experience neurochemically mediated comfort when social contact is re-established”(p.274).

To conclude, Panksepp’s theories, which are based on carefully collected and analyzed data, present a compelling account of the fundamental neurological principles of emotions. Panksepp’s contributions link cognition and behaviour with their neurological and neurochemical structures to provide new insight into the dynamics of the mammalian brain as the motivational source of our emotions. It offers a vital appreciation of the core structures of the brain as homologous in all mammals and consequently, it reunites our human psyche with the various conscious and unconscious states resulting from our common evolutionary journey with the animals.

### **Antonio Damasio: Body, Emotion, and Feeling in the Making of Consciousness**

*Feelings are not a mere decoration added on to the emotions, something one might keep or discard. Feelings can be and often are revelations of the state of life within the entire organism —a lifting of the veil in the literal sense of the term.*

—Antonio Damasio

Antonio Damasio’s intent to move toward the development of an anatomy of consciousness reveals how fascinating we really are. Stepping into the “light of consciousness” is Damasio’s metaphor for the birth of the knowing mind and the coming of the sense of self into the world of the mental. Following his landmark book *Descartes’ Error* (1994), in which he demonstrated that emotions are not a luxury, but

rather that they are essential to rational thinking and decision making, *The Feeling of What Happens* addresses the nature of body and emotion in the making of consciousness and outlines the role of emotion and feeling in the construction of self. Free from jargon and with careful summaries and restatements, *The Feeling of What Happens* is a compelling neurobiological account of the embodiment of feeling states and how they form the basis of self. Feelings, writes Damasio, along with their essential ingredients—pain and pleasure—are not well understood in biological and specifically in neurobiological terms. This is, he notes, “all the more puzzling considering that advanced societies cultivate feelings shamelessly, and dedicate so many resources and efforts to manipulating those feelings with alcohol, drugs of abuse, medical drugs, food, real sex, virtual sex, and religious practices.”

Damasio’s main theme is clear: he wishes to elucidate “the connection between emotion and consciousness, on the one hand, and between both of these and the body, on the other...” From Damasio’s neurobiological perspective, the problem of consciousness presents two enigmas: first, there is the issue of how the brain engenders internal images, how it “makes neural patterns in its nerve-cell circuits and manages to turn those neural patterns into explicit mental patterns” which he calls “movies-in-the-brain.” Movies-in-the-brain constitute the highest level of biological phenomena and involve the use of qualia or fundamental sensory qualities. Secondly, he wonders how, in parallel with generating movies-in-the-brain, the brain also engenders a sense of “self-in-the-act-of-knowing.” Although, from a biological perspective, these two aspects are nested one within the other, *The Feeling of What Happens* focuses squarely on the latter, the elucidation of the problem of self-in-the-act-of-knowing.

The innermost inspiration of the book is that consciousness is rooted in a feeling, a special kind of feeling: For Damasio, “consciousness *feels* like a feeling,” *a feeling of knowing*. Remembering why he began to think of consciousness as a feeling, he writes: “Consciousness feels like some kind of pattern built with the nonverbal signs of body states.” Damasio, a neuroscientist who is also very much a humanist, approaches the still shadowy country of consciousness grounded in years of clinical research with patients who are either epileptic, or have suffered brain damage through strokes, disease, or traumatic injuries, often studying consciousness from its absence. Clinical experience has taught him that consciousness and emotion are not separable. Although consciousness can be separate from wakefulness or low-level attention, consciousness and emotion cannot be taken apart from each other. When consciousness is impaired, so is emotion.

For the purpose of investigating the neural underpinnings and distinctions among emotion, feeling, and consciousness, Damasio has developed a processing continuum which moves from a state of emotion through a state of feeling, and on to a state of “feeling made conscious.” These three states are part and parcel of the *mechanism of life regulation* which he sees as unfolding on four interactive levels: *basic life regulation*, *emotions*, *feelings*, and *high reason* explained as a “customized plan of response formulated in conscious images and executed as behavior.” 1) At the first, most basic level, simple patterns of response,



such as reflexes or metabolic regulation, provide the organism with a survival-oriented homeostatic regulation whose purpose it is to avoid any loss of bodily integrity that could be a harbinger of death; these simple basic regulatory patterns promote the positive seeking of energy sources, shelter, or sex. 2) At the next, slightly more complex level, Damasio places emotions whose job it is to make the connection between the first level of basic survival-oriented homeostatic regulation and the “objects” within our autobiographical experience. Emotions, through such powerful learning mechanisms as conditioning, become value-laden and “are inseparable from the idea of reward and punishment, of pleasure or pain, of approach and withdrawal, of personal advantage and disadvantage,” and inevitably are linked to the creation of good and evil. Although Damasio approaches emotion from a perspective relatively uninfluenced by psychoanalysis or infant observation, he nevertheless hypothesizes a primitive unconscious self, altered by the interactions with its objects. This hypothesis, though a fundamental tenet of object relations theory, is apparently radical for neuroscience. 3) At a third increasingly complex level, basic sensory patterns of pain and pleasure, together with emotions, develop into mental images and become feelings. 4) Lastly, in a fourth stage, organisms who are capable of knowing that they have feelings—that is who are equipped with consciousness—reach a final level of regulation. Through the agency of feelings, emotions enter and permeate the thought process and thus reach consciousness. Linked by feelings, emotions and consciousness are part of a hierarchical regulatory continuum devoted to enhancing the organism’s adaptive responses and survival abilities. From this premise, Damasio continues on to delve into issues of consciousness and how the self becomes known.

What are feelings made of, what are feelings the perception of, how far behind feelings can we get? In *Looking for Spinoza*, Damasio continues his work with feelings, again making what they are, how they work, what they mean, the center of inquiry. Based on evidence not available when he wrote the previous two books, the main purpose of this book is to present a progress report on the nature and human significance of feelings in the hope of bringing forth new ideas on the subject. “Imagine,” he writes, “meeting someone who, as a result of damage to a certain location of his brain, became unable to feel compassion or embarrassment...yet could feel happy, or sad, or fearful just as normally as before the disease had set in” (p. 5). It is such encounters with the vagaries of neurological illness that give Damasio pause and stimulate his reflection on how the loss of a specific sector of brain circuitry brings with it the loss of specific kinds of mental events. Surprising to him is the fact that when patients lose the ability to express certain emotions, they also lose the ability to experience the corresponding feelings. Strangely, the inverse is not true: Some patients who lose their ability to experience certain feelings can still express the corresponding emotions. Intrigued by this strange asymmetry of relation between feeling and their antecedent emotions, Damasio now labors to elucidate the “web of mechanisms that allow our thoughts to trigger emotional states and engender feelings.”

Damasio is encouraged to articulate his evolving view of feelings by his recent re-connection with the writings of Spinoza, who died in 1677, and with whom he finds a pleasant resonance. In opposition to his

times, Spinoza proposed that the power of affect is such that the only hope of overcoming an irrational passion is to overpower it with a stronger *positive* affect; he recommended that we fight a negative emotion with a reason-induced positive emotion and not with pure reason alone. Spinoza's dissent with the prevailing Cartesian mind-body split of his time makes him stand out in a sea of conformity which lasted several centuries. He believed that "both mind and body were parallel attributes of the same substance," and held that "the human mind is the idea of the human body." Spinoza heartens Damasio's own conviction that "mental processes are grounded in the brain's mappings of the body, collections of neural patterns that portray responses to events that cause emotions and feelings." Spinoza built a philosophy based on an architecture of life regulation in which organisms "come into being with the capacity to regulate life and thereby permit survival, and where the striving to achieve a 'greater perfection' of function causes great joy." Spinoza's relevance to neurobiology stems from his preoccupation, contrary to his time and the thinking of his contemporaries, with seeking the biological grounding of the relation of human beings to nature. In opposition to Descartes, Spinoza suggested that the norms that govern our social and personal conduct should be shaped by a deeper knowledge of the God which manifests as Nature within our selves. Damasio weaves his fascination with Spinoza into the fabric of this book, thus anchoring himself in the history of a centuries-long struggle to bring the body into rightful relation to the mind.

Identifying with Spinoza, Damasio believes that if we care to look into the mystery of the mind-body, "there is more knowledge than meets the eye, if only the eye is theoretically free to see." He delves head-on into the mind-body problem. Refreshingly, he rejects outright the approach of substance dualism which splits the mind to one side and the body to the other. Are mind and body two different things or just one, Damasio asks? And if they are not the same, "are mind and body made from two substances or just one?" And if they are separate, does one come before the other? "Does mind come first and cause the body and its brain to exist, or does body come first and its brain cause the mind?" Damasio's patients are his teachers. Reflecting on the events that precede epileptic seizures, he noticed that "when the ongoing brain mapping of the body was suspended, so was the mind. In a way, removing the mental presence of the body was like pulling the rug from under the mind." He also noticed that the presence in the mind of the body's interior, namely the viscera and internal milieu, seems to be specifically useful in grounding the mind. He notes that although neurobiology has clearly revealed that mental phenomena are dependant on specific systems of brain circuitry, the existing evidence still provides little incentive for reflection and the resulting interpretations remain highly contested. He notes that in the attempt to close the original mind-body divide, the split has simply shifted its location; while new lines of inquiry now link the mind-brain, the "body-proper" is still outside the inquiry. By placing the mind-brain on one side and the "body-proper" on the other, the role of the body is still left out. Damasio's understanding of brain-mind-body is in process, but in *Looking for Spinoza*, he outlines useful principles that begin to reconcile the theoretical split that keeps science blind:

- The body-proper and the brain form an integrated organism that interacts fully and mutually via chemical and neural pathways.
- Brain activity is aimed primarily at assisting with the body's life processes by coordinating internal and external interactions. Brain activity is aimed at the body's survival and well-being.
- In complex organisms, the brain's regulatory operations depend on the creation and manipulations of mental images in the process we call mind. Images in the brain that relate to the exterior include visual, auditory, tactile, olfactory and gustatory images. Pain and nausea are images that relate to the interior. The anticipation and planning of future responses also require images.
- Mapping the organism is not a passive process. The structures involved in forming the maps have their own say and are influenced by other brain structures.

From Damasio's perspective, the brain produces two types of images: *images from the flesh* monitoring body structure and visceral states along with the chemical parameters in the organism's interior, and *images from special sensory probes* geared to make note of possible impingements upon the organism. Thus, foundational images in the stream of mind pertain to body events expressed in neural patterns of activity and inactivity. In the final tally, writes Damasio, "what ends up being mapped in the sensory regions of the brain and what emerges in the mind, in the form of an idea, corresponds to some structure of the body...." There currently continues to be a major gap in understanding how neural patterns become mental images; neural patterns are described with the tools of neuroanatomy, neurochemistry, and neurophysiology, while mental images are described with the tools of introspection. How to get from the former to the latter remains the speculative frontier of the work on consciousness.

As with Spinoza, Damasio's investigation of the nature of emotions and feelings and the relation of mind to body carries a broad, humanistic goal: "An understanding of the neurobiology of emotions and feelings is a key to the formulation of principles and policies capable of reducing human distress and enhancing human flourishing." In *The Feeling of What Happens*, Damasio conveys a hopeful message: if civilization's mandate is to improve human existence, and if civilization is the consequence of consciousness, then it is through the agency of consciousness that we have the means to improve civilization and human existence. We have no blueprint to follow, Damasio muses, and it is only by seeking to know about consciousness that we can hope to support the fulfillment of its homeostatic regulating role.

## THE NEUROBIOLOGY OF EARLY LIFE

**Affect Dysregulation and the Disorders of the Self** by *Allan Schore*. New York: W.W. Norton, 2003.

**Affect Regulation and the Repair of the Self** by *Allan Schore*. New York: W.W. Norton, 2003.

**The Developing Mind: Toward a Neurobiology of Interpersonal Experience** by *Daniel J. Siegel*. New York: Guilford Press, 1999.

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Studies of child-caregiver relational processes and their effects on the developing brain are leading to a deeper comprehension of the dynamics and essential significance of affective phenomena. These studies demonstrate that the maturation of the infant brain is largely influenced by the environment and is therefore experience-dependent, thus emphasizing how the infant's expanding socio-affective functions are critically influenced by the affect laden relational experiences offered by the primary caregiver. Developmental research suggests that the mother's body and affect act as regulators, permanently shaping the emerging self's capacity for organization. Interestingly, the caregiver-infant interactions are mostly hidden and nonverbal—the mother senses and attunes to the nonverbal affective expressions of her infant's psychobiological states and by doing so, helps her child modulate its internal states. When mistuned, these interactions, which permanently shape the emerging self's capacity for self-organization, leave enduring and difficult to modify vulnerabilities in the brain. Consequently, the emerging neuroscientific understanding of early development emphasizes the fundamental significance of affect regulation. This new vision is replacing old notions of mind and body dichotomy, supplanting them with an appreciation for the rich web of synergistic socioaffective relations that underlies healthy development.

### Allan Schore's Regulation Theory: The Art and Science of Optimal Balance

*The relationship between the dynamics of early development and the ontogeny of the emergent function of self-regulation is perhaps the most fundamental problem of development.*

— *Allan Schore*

Allan Schore, a pioneer in the study of the development of the self, is a theoretician with a deep interest in biology, who integrates the data and models from a wide range of diverse disciplines such as neurobiology, behavioral neurology, behavioral biology, sociobiology, social psychology, and developmental psychology. He weaves their numerous threads into a coherent tapestry that ties biological structure to its psychological function and constructs an overarching model of social and emotional development which he calls regulation theory. Schore's interest lies specifically in the social emotions, how they develop, and how they are influenced by the attachment relationship. His research shows how traumatic childhood experiences that leave a child unable to regulate the intensity of strong emotions are one of the overlooked roots of violence, of borderline and antisocial personality disorders, and at the very least, of a predisposition to violence.

In his groundbreaking book *Affect Regulation and the Origin of the Self* (1994), Schore argues with thorough, multi-disciplinary detail, that the early social environment, mediated by the primary caregiver, profoundly and inescapably influences the evolution of the structure of the infant's brain. He shows how the maturation of the right orbitofrontal cortex, the executive regulator of the right brain, is continuously influenced by the mother's regulation of the infant's bodily-based internal arousal states via psychobiological attunement, and is critical to the child's future capacity to self-regulate emotions, appraise others' emotional states, and manage stress. Schore argues that John Bowlby's attachment theory, a theoretical model that includes psychological and biological levels, has spawned one of the broadest, most profound and creative lines of research in twentieth century psychology. Schore anchors his thinking in Bowlby's work to demonstrate that the capacity for attachment is at the core of the social experience. In the psychobiology of attachment, the mother not only regulates her infant's behavior, but also its physiology. Attachment is now viewed as originating in the intimate mother-child experiences and serving the adaptive purpose of securing the mother's capacity to regulate her baby's distress and joy states. Using attachment theory, neurobiology, and infant psychiatry as primary models, Schore draws widely on psychoanalytic theory, including object relations and self-psychology, to put forward a comprehensive theory of affect which charts the development of emotional capacities as they evolve to increasing levels of complexity.

### ***Lessons already learned***

To set the stage for Schore's two new books, endearingly called the "red" and the "blue" books because of the color of their covers, it might be useful to review some of the valuable principles laid out in the 1994 "green" book, *Affect Regulation and the Origin of the Self*, that illustrates how the growth of the self is intertwined with the growth of the brain within the context of relationship:

- *Development is interactive in nature*, essentially representing a number of sequential, mutually driven infant-caregiver processes that occur in a continuing dialectic between the maturing organism and its changing environment.
- *Development is more than the study of changing functions; it is a progression within a structure-function relationship*. The infant's structure is continually organizing, disorganizing, and reorganizing into more complex structures. As more complex structures evolve, emergent new functions appear. Development is not a simple continuity, but a series of reorganizations within hierarchies, feedback loops, and evolutionary layers which allow for increased complexity, stability, and adaptivity. The brain is not a thing but a dynamic embodied process in which the whole is more than the sum of its parts.
- *The early environment is a social environment in which the mother is the primary social object*. The mother provides a stimulating or inhibiting *modulatory function*, essential to the experience-dependent maturation of her child's developing biological and neurological structures.

- *Affect becomes adaptively self-regulated.* It is of current interest to understand how the infant's affect, which is initially regulated by the mother, becomes increasingly adaptively self-regulated. Adaptive self-regulation, which is active from the molecular to the social levels, could elucidate the hidden processes of our psychobiological development.

These developmental progressions are dependent upon certain neurological principles:

- The structure of the brain is literally built on a daily basis at a stupendous rate, going from 400g at birth to 1000g at 12 months. More than any other organ, the growth and function of the brain is highly dependent upon the continued availability of its energy substrate, the caregiver. As the cells differentiate and form connections, a dramatic change in energy production and output accompanies the increasing complexity of structure and the efficiency and integration of function.
- The regions of the brain in most rapid growth are the ones most susceptible to external stimulation. The growth of the brain occurs in critical periods, with different regions of the infant's nervous system maturing at different periods and the individual layers in each cerebral lobe developing at their own rates.
- The infant brain becomes hierarchically organized in horizontal levels: Over discrete stages of development, each higher level re-represents and expands at a more complex level of organization those functions present in the previous, more primitive level of organization. Later developing higher cortical levels come to inhibit earlier developing subcortical levels.
- The highest level of organizational complexity occurs in the prefrontal cortex. This cortex, which performs an inhibitory function, develops postnatally. Because the caregiver serves as the external regulator of the infant's endocrine and nervous systems, the postnatal environment has an ongoing effect on gene expression and experientially shapes the genetic potential. On one hand, the neurohormones and neurotransmitters act as the internal clocks that coordinate the timing of developmental processes, on the other, they regulate gene transcription. Thus the external relation with the mother can directly affect the regulation of internal genetic events.
- Structures and functions that are adaptively suitable at one stage of development, are not suitable at later stages. These transient structures that are adaptive only for a restricted phase of development require a mechanism whereby they can be eliminated, suppressed, or reorganized. This mechanism, responsible for eliminating excess axons and pruning overproduced synapses, is called *parcellation*. Evidence shows that the development of the nervous system follows a general progression: a) an initial overabundant production of synaptic connections, b) a competitive selection of connections that are most effectively entrained to the environment, and c) a redistribution of input closely followed by the appearance of an emergent function. This "Darwinian" psychobiological process suggests that the stabilization of the organism is essentially driven by the environment.

It is now known, Schore writes, that the immature brain of a neonate is an entirely different brain than that of an adult. The neonatal cerebral metabolic rate that sustains cortical function is very low and the higher center of young brains are able to process only a small amount of information per unit of time, and this occurs in circuits that function more slowly than those of adults” (p.10). In the very early years, conscious explicit memory is not yet in place because of the immaturity of the hippocampus, whereas the basal ganglia and the amygdala are well developed at birth. Consequently, it is theorized, implicit memory is in place for experiences such as fear, somatic symptoms, or patterns of interaction derived from the mother-infant relationship. It is not until eighteen months of age that the hippocampus comes on line, and this parallels the onset of verbal activity.

The brain of the human infant lacks some of the neurological circuits necessary for the ongoing differentiation between what is self and what is other. Freud described the infant as floating in a state of “oceanic bliss,” without awareness that there is a limit to its own being. Forged out of the neurological impressions that assemble in bits and pieces, the sense of an outside reality joins the infant’s inner experience. James Grotstein has eloquently expressed how caregiver functions “unfold in an intricately coordinated series of contacts with the maternal-social environment—all in an orchestration of specifically timed phases of availability. . . that at first soothe, validate, and confirm, and then stimulate, challenge, and encourage” (p.xxi). These sequential interventions appear to be absolutely necessary for neural development and essential for the infant’s emotional development to occur. The child’s attainment of an efficient internal regulation capacity is absolutely dependent on the emotional responsiveness, the attunement, of the mother. The motive force of the attachment process is an interactive series of psychobiological attunements which consists of visual and emotional contacts interspersed within separations and reunions. When mediated successfully, this leads to a secure attachment which facilitates the internalization of the mother’s regulatory function. Early deprivation in maternal care retards the experience-dependent development of attachment and self-regulation.

### *New developments*

Schore’s two new companion volumes contain a combination of already published contributions along with new material that continues to synthesize and update current experimental data, theoretical concepts, and clinical observations. They expand the foundation and scaffolding of his overarching model of socioemotional development to present a comprehensive articulation of regulation theory as it has evolved since the publication of *Affect Regulation and the Origin of the Self*. Schore’s interest in the first two years of life is directed very specifically at how regulation impacts the emotion generating limbic system and the brain’s right hemisphere. The focus on regulatory phenomena, Schore wrote in 1994, “represents a powerful central linking concept that could potentially elucidate the ‘hidden’ processes in development and thereby organize what appear to be disparate bodies of developmental knowledge” (1994, p.7-8). Since then, “a consensus has been established that development fundamentally represents the emergence of more complex forms of self-regulation over the stages of the life-

span...” (2003, p. xv). Schore’s recent work continues to move powerfully towards an integration of the developmental sciences under the umbrella of regulatory attachment functions which impact all forms of cognition, affect, and behavior. According to Schore, the left hemisphere is not dominant until a year and a half when the child is speaking its first words. He suggests that early interactive experiences are specifically impacting the nonverbal right brain and that it is the right brain that stores the internal working models of the attachment relationship and processes emotional social information. In fact, it now appears that the brain’s early growth spans the last trimester of pregnancy through the second year, moving the focus of interest in early processes to the prenatal period.

Awareness of the impact of regulatory capacities on adult behavior leads us to question what kind of social and emotional experiences are needed for optimal development, and at what points. The various developmental models can now evolve to include a more precise understanding of critical or sensitive periods: in times of intensified growth, when increased synaptic production and differentiation are under way, the infant needs certain types of social and emotional experiences to support the most favorable brain growth. This brings the importance of a focus on prevention into the clinical picture. If the attachment relationship provides the ground for the modulation of the infant’s energy states, then it is at these points of heightened growth sensitivity that the caregiver’s receptivity to the infant’s cues is particularly crucial. Schore concludes that assessing infant development now means assessing not just the infant, but equally important, the nature of the infant/mother relationship. Attachment and separation happen on a micro scale, in the moment-to-moment awareness of fleeting perceptions that grow to be emotions and then moods. The quality of the mother/infant communication has become critical to the infant’s healthy growth and shapes the baby’s ability to form adaptive versus immature, dysfunctional, or dysregulating coping mechanisms.

These ideas, in turn, put in question our existing models of psychopathogenesis. The earlier the mother/infant dyad goes off track, the more problematic it is for development down the line. In this matter, Schore turns to Mary Ainsworth and Mary Main, central figures in the continuing development of attachment theory, who began to look at the attachment patterns between mothers and infants. Four classifications of attachment evolved out of their developmental studies: children’s attachment styles could be secure, insecure-resistant, insecure-avoidant, or, in a profoundly pathological group, insecure disorganized–disoriented. Main concluded that children in this last category, who presented more severe forms of psychopathology, suffered from the damaging impact of a mother’s abuse and neglect. Following Main’s findings, Schore looks at the neurological correlates of disorganized attachment. The impact on the brain of ongoing relational trauma, abuse, and neglect affects the development of specific pathologies such as PTSD, personality disorders, and violent behavior.



### ***The importance of positive emotions***

In the “blue” book, *Affect Regulation and the Repair of the Self*, the third volume in Schore’s triad on the critical relationship between affect regulation and the organization of the self, he seeks to identify fundamental mechanisms of psychotherapeutic change. He concludes that the amplification of positive emotions such as interest, excitement and enjoyment, and the fundamental bodily-based operations that lie at the foundation of these positive emotional processes are much more central than we thought. In early development, positive affects are key not only to psychological states that support growth, but also to physical health. As Panksepp showed, the brain uses pleasure and aversion mechanisms in its effort to maintain physiological consistencies; the attempt to minimize unpleasant feelings and maximize pleasant ones is associated with survival and therefore is a core driving force of motivation. When the attachment to the mother is well established, it not only minimizes negative states but, more importantly, maximizes positive states. In addition to looking at trauma and the effects of negative emotions, psychoneurobiology now indicates that play experiences and the mother’s ability to modulate high joy states are of central importance to healthy development.

### ***The implicit self***

Schore points out that “most moment-to-moment psychological processing occurs nonconsciously.” Both researchers and clinicians are converging upon the fact that “rapidly communicated nonconscious social emotional information is primarily processed and acted upon at the implicit rather than the explicit level.” Given that in relationship much of the exchange of essential subjective information includes nonverbal dynamic exchanges in facial expression, prosodic tone of voice, touch, gesture and bodily states, cognition is being redefined to include not only a verbal-conscious component, but also a nonverbal-unconscious aspect. Verbal reappraisal strategies whereby we mentally talk to ourselves in order to regulate our anxiety are lateralized to the verbal left hemisphere. It now appears that there is another form of regulation strategy, one that does not involve an interpretive verbal component, but is lateralized to the right prefrontal areas. Dominant for coping with stress and uncertainty, and specifically accessed in states of very high or very low arousal associated with intense emotions, it is this right-lateralized nonverbal affect regulating function which is essential to the functioning of the implicit, as opposed to explicit, self. It is these data on the implicit functions of self that form the major portion of Schore’s third volume.

Schore is acutely aware of the profound social implications of his findings. The future of a society resides in its children. The mother/infant relationship is central to the formation of a sense of self, to positive and negative concepts about the world and energy states, to self-regulation and the ability to regulate internal bodily states, to the capacity for empathy, to the ability to read the states of mind of other human beings. What human beings learn in their first interactions with their caregivers does not come out of later language forming situations. If it is true that early events are critical for the psychological development of human beings, then this is where a society must put its resources.

## Daniel Siegel: The Neurobiology of Interpersonal Experience

*What is the mind? How does the mind develop? . . . The mind emerges at the interface of interpersonal experience and the structure and function of the brain.*

—Daniel Siegel

Allan Schore and Daniel Siegel are blood brothers of sorts. Both carry similar messages, each from his particular vantage point. Both Allan Schore and Daniel Siegel, along with Regina Pally (presented in Part I of this review), and Lou Cosolino (who will be introduced in our next segment) were members of the Los Angeles study group called the *Institute for Development and Clinical Neuroscience*. Drawing on the same neuroscientific information as Schore, Siegel, a psychiatrist who specializes in the care of children and families, explores the idea that “mind emerges at the interface of interpersonal experience and the structure and function of the brain.” Siegel constructs a conceptual foundation for an interpersonal neurobiology keeping in mind that “we do not stop developing even as we grow past childhood and adolescence.” Although in the first three years of life, a toddler’s brain grows to two thirds its full size—a special window of opportunity for emotional lessons—the neural networks that make us who we are grow, develop, and change in response to human relationships throughout the life span. The nature of the neurobiological basis of the developing mind makes it clear that nobody builds or sustains their own brain. Filled with illustrative examples from clinical practice and everyday life, Siegel has developed a united conceptual foundation that ends the nature-nurture debate. This book is probably the most accessible and eminently practical for understanding and applying developmental neurobiology to clinical practice.

Curious about “how mind emerges from the substance of the brain,” Siegel begins with an introduction to what is known about the mind’s development by synthesizing the scientific findings of child development, memory, emotion, narrative, and attachment. The way the mind encodes elements of experience, and the way these encoded elements shape children’s representational processes, leads him to conclude that early experiences are engrained in children before they have an autobiographical memory. He shows how, according to the findings of attachment research, it is the parent’s autobiographical narratives that most importantly set the stage. Siegel writes that “the most robust predictor of a child’s attachment to parents is the way in which parents narrate their own recollection of their childhood experiences.” This implies that it is not so much *what* an adult recalls, but rather *how* it is recalled, that predicts how that adult will relate to a child. The practical relevance of this finding highlights the import of coherent *emotional* communication to facilitate the development of mind. Emotional communication and the alignment of emotional states are seen as primary ingredients in a child’s evolving identity and healthy functioning. In agreement with Panksepp, Siegel views emotion as “the fundamental process of the mind that links states of arousal with the appraisal of the value or the meaning of its own representational processes.” Research into the nature of emotion provides a key to how the “connection between meaning and interpersonal experience occurs because these two processes appear to be mediated via the same neural circuits responsible for initiating emotional processes.”

Siegel goes on to examine other important areas of research on interpersonal development: the brain's asymmetry and lateralization of function, the application of non-linear dynamics in complex systems to the functioning of two or more minds acting as a single system, the organization of self-regulatory abilities resulting from the modulation of emotion through energy flow and appraisal of meaning, how patterns of communication between a parent and child determine the ways in which self-regulation emerges, how coherent narrative articulation establishes a secure flow of self-states across time and thus facilitates integration, consistency, and continuity of mind.

The concept of *integration*, and the various ways in which integration can be understood, form the subject of Siegel's last chapter and integrates the information presented in the book. Integration is defined as "the collaborative, linking functions that coordinate various levels of processes within the mind and between people." Throughout this fascinating chapter, Siegel looks at how normal development appears to move in the direction of more differentiated and integrated states. Neural integration at both micro and macro levels is fundamental to self-organization and to the brain's capacity to create a sense of self. Reality is shaped by the way our representational processes link internal and interpersonal worlds. At the microscopic level, based on anatomical neural circuitry, integration can take a number of forms including: 1) A *vertical* integration between the "lower" functions of the brain stem and limbic regions and the "higher" cognitive and motor planning operations of the frontal cortex, 2) A *dorsal-ventral* integration which brings together the dual origin of the frontal cortex from the archicortical and paleocortical regions of the paralimbic cortex. Each hemisphere has a dominant pathway: right with dorsal, left with ventral, 3) A *lateral* integration which coordinates the reentry of perceptual processes across sensory modalities, bringing together, for example, visual with tactile and/or auditory stimuli to create a "whole picture" of an experience. At the macroscopic level, Siegel makes a distinction between *intraindividual* and *interindividual* integration. Intraindividual, in that we interrelate internal developmental achievements across our lifespan and learn to function with relatively minimal internal conflicts among the various adaptive aspects of self; interindividual, in that it is essential to our well-being that we integrate into a coherent experience of self the multiple self-states constructed from our relationships with children, caregivers, and peers.

In the end, Siegel concludes, it is the autobiographical "coherent narrative [that] reveals a blending of left- and right-hemispheric processes" that makes known an individual's level of integration or incoherence. Bilateral integration promotes a coherent narrative in that the interpreting left hemisphere is driven to weave a tale to make sense of the emotional, somatosensory right hemisphere's representational processes. Siegel concludes that "emotional attunement, reflective dialogue, co-construction of narrative, memory talk, and the interactive repair of disruptions in connection are all fundamental elements of secure attachment and of effective interpersonal relationships." It is in the vital feeling of connection, in the experience of fully engaged communication that we come alive and that "one can appreciate the power of relationship to nurture and to heal the mind.

## CONCLUSION

*The attuned, intuitive clinician, from the first point of contact, is learning the nonverbal moment-to-moment rhythmic structures of the patient's internal states, and is relatively flexibly and fluidly modifying her own behavior to synchronize with that structure, thereby creating a context for the organization of the therapeutic alliance.*

—Allan Schore

It was not so long ago that the argument was made that brain science was reductive and deterministic and therefore dangerous to psychotherapy. Now it is becoming clear that, far from narrowing our focus, it is adding new depth to our understanding. The increase in research focusing on affect, paralleled by investigations into the ontogeny of brain systems, sheds new light on the mysteries the body-mind-brain connections as well as on the requirements of early development. The recent data on affect and early development are shaping psychobiological models of infancy and adulthood that should bring us to reassess what makes therapy work and how it fails, as well as encourage reflection upon how we conceptualize our psychotherapeutic role and interventions.

Emotion binds together virtually every type of information the brain can encode. Jaak Panksepp's emotional operating systems remind us of the potency of our basic drives. Their relentless trajectory towards homeostatic balance, designed to optimise human life, is achieved when the organism feels "right" in relation to its environment. The complex mission of psychotherapy is revealed in the idea that an emotional operating system has to be activated—it has to be 'live' and 'real' in order to be explored on a variety of interrelated levels. Moreover, we must take into account the fact that the basic emotional operating systems are embedded in sub-cortical structures which, when over-activated, inhibit thinking which is processed at the cortical level. It appears that psychotherapy must engage our intrinsic affective potentials in a manner that enables them to become active within the context of a relationship where they can be felt in order to be understood and regulated. A key component of such relational therapy would be to bring together a patient's capacity to have bodily felt experiences together with a reflective capacity about his or her emotional relationships to other people. Consequently, in order to support change, there is a growing movement towards relational forms of psychotherapy that support the importance of *having emotional experiences in real time with the therapist*. This fleshes out the psychoanalytic theory that structural change in the psyche happens through the exploration of the transference/countertransference relationship. Though already largely identified in the theories of object relations, and therefore not an entirely new idea, what is new is the understanding of the far reaching effect of early trauma and chronic relational deficits on the loss of the ability to regulate one's feelings and physiology.

The most fundamental insight brought into focus by recent developments is the profound lifelong consequences of the success or failure of early attachment relationships. The early social-emotional interactions between the primary caregiver and the infant impacts the development of the baby's brain and

is determined partly by genetic factors and partly by relational affective experiences. Attachment is the outcome of two factors, the infant's genetically encoded psychobiological temperament and the nature of the caregiving experience. In the nature versus nurture balance, Allan Schore and Daniel Siegel's work on the regulatory function of attachment relationships gives us an understanding of how, when developmental needs are not met, the dysregulation of body-brain-mind organization has serious lifelong mental and physical health implications that can set awry the specificity of the neurochemistry programmed to follow a precise developmental timetable. When there are developmental failures, and consequent interconnected breakdowns in regulating systems and compensatory defences, it is hard to evoke the spontaneous life-affirming responses that are the gift of good health. Research on the mother's role has highlighted her importance not only as an amplifier and regulator of her infant's frustrations, but also of her infant's positive states. Much of psychotherapy is still geared towards the removal of symptoms and negative emotions and not towards the implementation of positive states. This focus on the importance of the regulation of positive states has yet to be fully explored and incorporated in our psychotherapeutic practices. Viewed from the perspective that all forms of psychological disorders are marked by affective dysregulation, and all forms of psychotherapy are forms of affect regulation, the therapist can be seen as a psychobiological regulator of the patient's affective states.

Developmental affective neuroscience is looking at how the relational interactions between mother and infant, and among all human beings, alters internal biological, neurological, and chemical structures. Research points to the fact that the attachment relationship impacts the connections between the brain and the immune system and so, can lead to new insight into psychosomatic disorders. When the focus is on affect, attention logically turns to the body because affect cannot be approached in purely cognitive terms. Important to our somatic field is the fact that mapping bodily states—changes in heart rate, respiration, or muscle tension, tracking of visceral variations, autonomic temperature and skin color shifts, etc.—is increasingly found to be fundamental to processing emotion. Thus, affective and developmental neuroscience are turning toward the body and confidently leaving behind the old Cartesian mind-body gap. The growing reciprocal connections between biology and psychology bring a new appreciation for the intricacies of the body's ability to adapt to the environment and move us toward a search for more dynamically holistic models.