
Playing on the Right Side of the Brain

An Interview with Allan N. Schore

Allan N. Schore has served on the clinical faculty of the Department of Psychiatry and Biobehavioral Sciences at UCLA's David Geffen School of Medicine since 1996 and has maintained a private clinical practice for more than four decades. He has contributed significant research to the disciplines of interpersonal neurobiology, affective neuroscience, psychiatry, psychoanalysis, psychotherapy and clinical social work, and infant mental health and trauma theory. He is best known for his integration of neuroscience and attachment theory, his idea of attunement between mothers and infants, his investigation of right-brain regulation of emotion, and his applications of neuroscience in psychoanalysis and models of psychotherapy. Given the Scientific Award from the Division of Psychoanalysis of the American Psychological Association in 2008, he is a prolific writer whose works include *The Science of the Art of Psychotherapy*, *Affect Regulation and the Origin of the Self*, *Affect Dysregulation and Disorders of the Self*, and *Affect Regulation and the Repair of the Self*. In this interview, he discusses his scholarly and clinical career in neuroscience and neuropsychology and the breakthroughs in brain science that have changed our understanding of lived experience. **Key words:** affect regulation; attachment theory; neuroscience; mind, brain, and body; regulation theory; right brain

American Journal of Play: Can you tell us about your own early play?

Allan N. Schore: I think a childlike sense of playful wonder and exploration has been with me from my very beginnings. It's the way my mind works and therefore a central core of my subjectivity. As a child, I treasured play, both physical and mental play, both solitary play that exercised my imagination and intersubjective play that let me share my imagination with others. I have an intense curiosity that traces back to my early childhood in Manhattan in the late 1940s. Both my parents recognized and cultivated this inquisitiveness. That George and Barbara were my parents was both

a cosmic accident and my good fortune. My mother was extremely warm and sociable, yet had a very strong personality. She built up my self-esteem and my sense of self, but she set limits and curbed my grandiosity. My father had a very pragmatic mind, but he was also sensitive and empathic, with a capacity to form emotional bonds with diverse people. I had strong attachments to both of them, and they provided an emotional context that supported my playful activities and budding creativity.

AJP: Did you consider your father a role model?

Schore: My father was a chemical engineer and an international expert in metal finishing and water pollution. He held numerous patents on electroplating copper and gold-recovery processes and received in 1976 an award from the federal Environmental Protection Agency “in recognition of having contributed major efforts and demonstrated a significant advancement in our nation’s continuing struggle for environmental pollution abatement.” His work was always at the cutting edge, even ahead of its time; his career, like mine, significantly changed over his life. So I was exposed to the mind of a creative scientist who was continually translating advances in basic chemical science into practical applications. And, yes, he was a role model: today, the EPA plaque hangs in my office.

And I constantly learned from him. When I was twenty-one and between college and graduate school, I spent about a year working with him. At that time, he was designing and building the first automated metal finishing systems for companies like General Electric, General Motors, and IBM. On one occasion, in particular, he taught me something invaluable. We took a trip to Tampa, Florida, where he gave a sales presentation to build an automation system for Honeywell. I saw him effortlessly field questions posed by a variety of experts—an electrical engineer, a chemical engineer, a mechanical engineer, a water pollution expert, and vice presidents from three different departments. He was going back and forth answering each of their technical questions, talking about the automation system in terms of its impact on all of these different fields, and then creatively integrating that information into a system specifically tailored to their needs.

Watching my father play the polymath’s role, I thought that’s the professional mind I need most to nurture in myself—the one that knows the different languages of experts and communicates with a number of different professions. An ability to move fluidly between disciplines would become

the model for my career as a scholar—a synthetic, integrative approach as opposed to the more typical specialization and narrowing of one’s interests in one’s own field. This evolved into the interdisciplinary perspective that characterized my work and led me to create a theoretical model that not only describes but integrates various scientific disciplines, for example, charting the points of contact between psychology and psychiatry, biology and chemistry.

AJP: When did you turn to the biology of human emotion?

Schore: In 1970, when I began my career in psychotherapy, I worked closely with a wide variety of patients to learn the craft. But over the next decade, another important aspect of my development occurred—my wife Judith and I created a family. Becoming a father to a daughter and then a son transformed me emotionally, particularly when they were infants. Their early and instinctual desire to play greatly impressed me. Early development, an area that had always intrigued me scientifically, played out before my eyes. I spent a good deal of time not only observing but naturally regressing into states of early parent-infant play.

Then in 1980, in my late thirties, I decided to cut back at work, thinking I might devote time to writing. I was unsure about my specific goal, but broadly I hoped to integrate biology and psychology by looking anew at the relationship between organic and functional disorders. This turned into a ten-year period of independent study, a decade before I would put pen to paper (to use a late twentieth-century, now almost-obsolete metaphor). My experience both as a patient in psychotherapy and a therapist with ten thousand dutiful hours of clinical work had not only allowed me to develop expertise and confidence in clinical psychology and neuropsychology but also had fueled an intense curiosity about the relational processes of psychotherapy. This curiosity led me to ask: How do minds and brains align with and shape other minds and brains? I left my clinical position at the Psychiatry Department at Kaiser Permanente and cut back my private practice from five to three days.

AJP: Did this give you the time felt you needed?

Schore: Yes. For about three out of every four Saturdays, and over the course of ten years, I explored the stacks of the California State University Northridge library—just a mile from home—like a child in a candy store (again pardon the mid-twentieth-century reference), roaming between its sections on psychology, psychiatry, biology, chemistry, and even the physical

sciences. When my children Beth and David were old enough, they came along, riding their bicycles around the campus while I searched out books and journals and fed quarters to hungry copying machines. You might say, as my kids biked around campus, I played around in the stacks, led almost entirely by my long-nurtured curiosity and trusting absolutely to my intuition about what to read beyond the fields in which I had earned my degrees. I did not read the articles in the library; I brought them back where I could spend time analyzing and synthesizing them, expanding my earlier education, not by studying at a university, but by playing in my home. I enjoyed these long, playful states of flow out there in the library and back at my home office: I was acting out in daily life my long-held wish to become a scholar of many disciplines.

AJP: How did independent exploration differ from formal study?

Schore: Once freed from the pressures of examinations—and with no need to explain or solve anything in particular and no need to publish—my mood became surprisingly positive, and I was imbued with the joy of learning new information from different fields. My confidence and intense curiosity increased as I realized I could master a variety of disciplines, and so I spent a number of years reading journals in not only psychology and psychiatry but also cell biology, neurochemistry, neurophysiology, and neuroanatomy. I looked especially closely at changes that took place over the early developmental periods of an organism's life-span. Over time, I found that my creativity expressed itself not in linear, analytical intellectual work, but in the nonlinear, positively charged emotional play states I mentioned, states of flow which—though they wandered—lasted for long periods of time. In these creative play states, research often spawned excitement and joy. These, in turn, generated thought experiments that triggered novel solutions. I personally experienced how play facilitates the processing of novel but useful information, which improves creativity and increases the capacity to learn. In fact, throughout the 1980s, I fell routinely into both intellectual and emotional states of flow. You might say I had become something like the polymath I admired in my father. I certainly grew adept at moving between different scientific and clinical literatures and between studies of the brain and studies of the mind.

AJP: What did you discover during this time?

Schore: In every third or fourth notebook, I found myself recording patterns across fields, and I began to integrate different research literatures,

especially developmental biology, developmental neurochemistry, and developmental psychology. Meanwhile, I shuttled between my study and consulting room where I concentrated more and more on the relational processes that lie at the core of psychotherapy. The work expanded my skills as a clinician-scientist, the term I found that best fit my emerging professional identity. As a clinician, I made careful observations about my patients' and my own subjectivities, especially about the emotional interactions between the two. But as a maturing scientist, I took careful note of the research I found convincing, research I would later use to develop an interdisciplinary theoretical model. I focused on the boundaries between fields and looked closely at the commonalities that lie beneath the surfaces of apparently unrelated phenomena. I became increasingly confident about theoretical concepts that cut across different sciences. Ultimately, I found that the construct of regulation lies at the core of chemistry, physics, and biology, and I knew that any overarching developmental or clinical model could be centered around this organizing principle. Hence my deep interest in the problem of self-regulation, a central dynamic of the human experience.

Halfway through my decade playing scholar, I had become absolutely confident that by creating a theoretical model of emotion and human relationships which integrated psychology and biology I could alter the course of clinical theory and practice, and indeed science. And even though my self-image is basically that I am a modest man, again something I learned from my father, I became comfortable with that explicit sense of conviction and confidence, even certainty, in the power of the model my mind was creating.

AJP: How did you know when you had had enough independent study?

Schore: Over the years the stack of legal-sized note pads grew six feet high and began to teeter precariously, which may have contributed to my intuitive sense that I needed to end my solitary investigation and finally write something. I had in mind a psychoneurobiological formulation of emotional development, both in early life and in the therapeutic process I was observing in my practice. It ultimately became my first book, *Affect Regulation and the Origin of the Self: The Neurobiology of Emotional Development*. Even before the book had hit the stands, I remember feeling the intense satisfaction of knowing that I had accomplished what I had set out to do.

AJP: How did your colleagues receive the book?

Schore: In 1994, after the book was published, I wrote letters to sixty researchers around the world—psychiatrists, psychoanalysts, neuroanatomists, neurochemists, brain researchers, cell biologists, developmental psychologists, and others I had cited, and I sent them copies of the book. By the end of the summer about fifty had written back to congratulate me on the work and its interdisciplinary perspective. Of the positive notice I got, I was especially proud of the review in *British Journal of Psychiatry*, which called me a polymath. And I felt good, too, that there was an acceptance of my emphasis on developmental psychoanalysis and on the work of Sigmund Freud, who had fallen out of fashion in academia.

AJP: Can you speak about Freud's hope of creating a biology of the mind?

Schore: Recall that Freud originally trained as a neurologist and he predicted that "we shall have to find a contact point with biology." In his 1895 *Project for a Scientific Psychology*, he attempted to construct a model of the human mind in terms of its underlying neurobiological mechanisms. It was in this endeavor "to furnish a psychology which shall be a natural science" that Freud introduced the theoretical concepts at the core of psychoanalysis, including ideas about regulation, the unconscious, development, and emotion. In the *Journal of the American Psychoanalytic Association*, I wrote in 1995 that advances in the interdisciplinary study of emotion indicated that the central role played by regulatory structures represented a confluence with Freud, and I called the time right for a rapprochement between psychoanalysis—the science of the unconscious mind—and neuroscience, the science of the brain.

AJP: Were you also still promoting Freud's therapeutic mission?

Schore: In the sense that I wanted to move Freud's *Project* forward. His original model of the psychodynamics of the psyche was influenced by the neuroscience of his time. Thus it was a drive-reduction model—the down regulation of ego over id, or to put it less technically, of rational insight over emotion. For Freud, ideally, therapists should remain emotionally neutral and detached; we would say that the left hemisphere dominated their approach. In addition, the Cartesian mind-body split remained at the core of Freud's theory. Thus there was little room in Freud's drive-reduction theory for body-based positive emotions. Neither, crucially, was there room in Freud for their up regulation and amplification in play states. His theory was essentially intrapsychic and not interpersonal. So he discounted states like mother-infant play.

Donald Winnicott's later emphasis on play broke away from classical psychoanalytic theory—so did relational psychoanalysis, which transformed the theory from a one-person psychology to a two-person psychology. As an argument for the power of integrating the psychological and the biological, the scientific and the clinical, *Affect Regulation and the Origin of the Self* was in part a response to and a taking up of Freud's *Project for a Scientific Psychology*.

Attachment theory, founded by the British psychoanalyst John Bowlby, represented his own attempt to reinstate Freud's *Project*. Toward that end, Bowlby's theory integrated ethology—or behavioral biology—and developmental psychology. Focusing on emotional development, in *Affect Regulation*, I expanded upon Bowlby's idea that the major motivational system involved in the attachment dynamic was the mother's regulation of the infant's fear states (a concept borrowed from Freud). I suggested that instead the attachment relationship regulates both distressing negative and playful positive states. I explored mother-infant play in early and late infancy, and I linked these experiences, which expose the child not only to improvements in learning capacity but also to brain development.

My first book thus represented a primal formulation of interpersonal neurobiology, a biopsychosocial perspective of human development that enables us to understand how the structure and function of the mind and brain are shaped by experiences, especially emotional relationships. Its interdisciplinary perspective also attempted to understand how brains align their neural activities in social interactions.

It was my first articulation of regulation theory, an interpersonal neurobiological model of the development, psychopathogenesis, and treatment of the implicit subjective self. And I am proud that the intersubjective brain-to-brain, mind-to-mind, body-to-body construct I explored in the book has subsequently been incorporated into the mental health professions as part of the ongoing relational trend in psychotherapy. In the book, I also outlined the core principles of modern attachment theory, which integrates biology, psychology, and psychiatry to conceptualize attachment transactions of early right brain-to-right brain socio-emotional communications.

AJP: Did Freud influence your thinking in other ways?

Schore: Yes, principally in my work in the new field of neuropsychoanalysis—the study of the neurobiological development of the unconscious mind. My

clinical experiences with patients and my own psychotherapy drove home for me, both objectively and subjectively, the essential nature of the unconscious in everyday life. And so I became intensely curious and interested in the unconscious and its essential psychic operations, 90 percent of which lies below the surface of the conscious 10 percent of the mind. For the last three decades, I have produced a large body of clinical and research data that indicates the right brain is the psychobiological substrate of the human unconscious. Over this period, a paradigm shift has occurred within the concept of the unconscious. In its updated reformulations, this central construct of psychoanalysis shifted from an intrapsychic unconscious that expresses itself in dreams at night to a relational unconscious in which, during everyday life, the unconscious mind of one individual communicates with the unconscious mind of another (right brain-to-right brain via an interpersonal neurobiology).

AJP: So what is the unconscious in your view?

Schore: I view the unconscious as essentially an emotion-processing system that acts rapidly beneath levels of awareness. And I have company in this point of view. In a chapter for *Adolescent Psychopathology and the Developing Brain* [2007], neuroscientists Don Tucker and Lyda Möller noted that the nonverbal emotional communication rooted in the right hemisphere suggested a domain of the mind much like the psychoanalytic unconscious that Freud described. The neurologist Guido Gainotti separated a schematic level in the right hemisphere that generates true emotions from a left brain that processes, analyzes, and controls emotions at a conceptual level. Russell Meares asserts that the brain's right side creates an "inner, emotionally laden experience" and a self-system that generates "a background state of well-being." And so there is now consensus that the conscious, surface "left mind" is located in the left brain, while we find the deeper unconscious "right mind" in the right brain.

AJP: Why did twentieth-century behavioral and cognitive psychologists avoid accounting for emotion?

Schore: The dominant behavioral psychology for much of the last century emphasized overt behavior, which explains the reluctance among scientific researchers to peer into "the black box." The behaviorists thus basically banished the mind, the brain, and the body from their scientific study. They focused instead on voluntary behavior and conscious processes, and they aggressively attacked both Freud's unconscious and the concept of

subjectivity. And because much of emotional processing occurs beneath levels of conscious awareness, they directed their attention away from affect.

AJP: What impact did this thinking have on thinking and research about play?

Schore: Behaviorists conceptualized play solely and narrowly as a behavior and not as an emotional state. In the 1980s, however, psychology's emphasis shifted to cognition, which legitimated the study of implicit, covert processes, and revalidated unconscious processes. Yet most saw cognition as a voluntary control mechanism of emotions, so here again they conceptualized play narrowly as the expression of cognitive processes. As a result, the deeper mechanisms of emotion and motivation continued to be ignored. That said, I have written about an ongoing paradigm shift from the behavioral psychology (and behavioral psychotherapy) of the 1960s and 1970s to the cognitive psychology (and cognitive psychotherapy) of the 1980s to the today's scientific exploration of body-based emotions, when therapy has become focused on affective psychobiological states.

This shift continues to affect thinking in neuroscience and neuropsychology—from investigating into the explicit, analytical, conscious, verbal, rational left hemisphere to refining our understanding the implicit, integrative, unconscious, nonverbal, body-based emotional right hemisphere. A major theme of this paradigm shift finds expression in the increasing trend within psychology, psychiatry, and neuroscience to emphasize the centrality of emotion (even more than cognition) in the human experience, “the primacy of affect.” Current psychobiological studies indicate that affects are not merely by-products of cognition—they have unique temporal and physiological characteristics that define our internal experience of self more than thoughts do.

AJP: Does this new approach hold implications for the study of play?

Schore: The shift away from the narrow constraints of a strict behaviorism has sanctioned scientific study of internal states, and so it has created an environment that supports a new generation of methodologies that more directly access the proximal internal causes of overt behavior, including play behavior. The current paradigm shift has also served as an antidote to the Cartesian sundering of mind and body that has plagued psychology and psychiatry. For most of the last century, these models overemphasized symptomatic negative, fearful, and anxious behaviors and underemphasized affect-driven joyful play states. Furthermore, this movement of research from behavior to cognition to body-based emotion forged stronger

connections among the disciplines of psychology, neuroscience, and psychiatry. They are all now focusing on affective phenomena, the essential components of body-based play states.

AJP: Tell us more about your interest in human development—do you think the old rule still holds that development before birth is genetic and development after birth is learned?

Schore: The shift from the verbal left to the nonverbal right brain has proven essential to our understanding of the preverbal stages of infancy. Research now questions previous views of development based solely on the ontogeny of cognitive language rather than emotional and social functions. That old rule you mention, still postulated by many scientists, turns out to be incorrect. Learning occurs in prenatal stages, *in utero*, between mother and fetus. For example, the emotional state of a mother affects her fetus: the amount of cortisol crossing the placenta affects the fetal genetic system.

This all makes more room for experience in neurological development. Indeed, a large body of interdisciplinary research has demonstrated that early brain development is not merely genetically encoded. Instead, such development depends especially on social-emotional experiences with the care giver. Scientists now describe gene-environment interactions and offer models that show nature and nurture combining to shape human development. Epigenetic factors regulated by a social environment that directly affects genomic mechanisms, turning genes on and off, find expression in both the mother-fetal and the mother-infant attachment relationships.

AJP: When does the mother-infant attachment relationship actually begin?

Schore: The short answer is earlier and earlier. Over the past several years, developmental research has moved the beginning from late in the first year to the first stages of infancy. In the work I have published most recently in the *Infant Mental Health Journal* [2017], I emphasize that developmental studies now need to move even further back to the period of life before birth. This primordial period of human development has been mostly ignored by science. But a growing body of studies on fetal brain development argues against the long-held idea that a fixed, inborn temperament represents genetic factors first expressed at birth. We now think instead that temperament at birth is a result of prenatally evolving epigenetic mechanisms that continue to be shaped or misshaped by the postnatal social-emotional environment. Thus in the earliest of human beginnings—the prenatal *and*

postnatal stages of human development—the fetus and then the infant evolves through a succession of critical periods. In both the *in utero* and then extrauterine environments, experience-dependent stages of brain growth can both support or inhibit the development of more complex brain structure and function.

AJP: Tell us about the period after birth you call the process of attunement.

Schore: Secure attachment depends upon a mother's attunement not with her infant's cognition or behavior but instead with her infant's dynamic alterations of autonomic arousal, the energetic dimension of the child's affective state. And here the musical metaphor of attunement is both helpful and telling. To enter into this communication, a mother must be psychobiologically attuned to the dynamic crescendos and decrescendos of her infant's body-based internal states of peripheral autonomic nervous system arousal and central nervous system arousal. Through right brain-to-right brain nonverbal visual-facial, auditory-prosodic, and tactile-gestural body-based affective communications, a care giver and infant learn the rhythmic structure of the other and modify their behavior to fit that structure. Thereby they cocreate a moment-to-moment, specifically fitted interaction. During this affective communication, an attuned mother synchronizes the spatio-temporal patterning of her sensory stimulation with her infant's spontaneous organismic rhythms. Through this contingent responsiveness, a mother appraises the nonverbal expressions of her infant's internal arousal and affective states, regulates them, and communicates them back to her baby. Thus a mother's responses are finely attuned to the moment-to-moment changes in her infant's facial expression, vocalization, and body movement. Her own state is in turn affected by changes in her infant's state.

AJP: How can you tell when mother and infant are attuned?

Schore: The major indicators are pleasure and interest.

AJP: Then is attunement more a matter of feeling than thinking?

Schore: Psychobiological attunement is a right-brain process. In a 2011 article for *Neuroscience Research*, Shota Nishitani and his colleagues showed that the right (and not left) prefrontal cortex is involved when human mothers discriminate their infants' facial emotions. Importantly secure mothers attune to both their infants' positive and negative facial communications. Studies of the mothers' EEG responses to videos of their own five- to eight-month-old infants during free play show right frontal activation. In these peek-a-boo episodes, maternal affect matches infant joy. But the mothers'

right frontal areas are also activated during episodes of infant distress. When they see their own infants in distress, mothers express negative affect matching—sadness, concern, irritability, and the absence of joy. In turn, this empathic, right brain-to-right brain attunement sets up a bidirectional relational context for mutual regulation—coregulation, if you will—of each of their affective states. This interactive regulation allows a shared positive affective state in both mother and child. These dynamics operate in the earliest forms of positive, emotionally charged mother-infant play, during which a mother initially matches her internal state with her infant's state.

Mothers overtly express this matching in their facial expressions, tones of voice, and gestures to resonate with her child's body-based emerging subjectivity. For example, the temporal contour of a maternal nonverbal vocalization might match in a way that gives a sense of what she sees in her infant's face. This kind of matching is not imitation and it is not an exact copy—it is analogical. Her face and her voice represent analogues of the baby's state. As Donald Winnicott observed, a mother looks at her baby and what she looks like is related to what she sees in her child. Furthermore, these implicit, rapid, spontaneous, intersubjective, and body-based, nonverbal communications occur at levels beneath a mother's conscious awareness.

AJP: How does play help mothers and infants attune?

Schore: A care giver, even one in whom the attachment bond is secure, will not always be perfectly attuned—indeed, studies show such attunement occurs less than 30 percent of the time. Instead, the “good enough mother” can monitor the changes in her infant's state and alter her response as needed. She reattunes. Recall that she is psychobiologically attuning not to her infant's external behavior but to the baby's internal rhythms of arousal. This interactive regulation of reattunement brings the infant back into autonomic balance and homeostasis, reestablishing the feelings of safety and trust. The disruption of the attachment bond leads to a transient stressful response of negative affect and a temporary loss of safety and trust. In a pattern of interactive repair following dyadic misattunement—of disruption and repair—a secure bond lets the mother and infant transition fluidly from a positive attuned state to a negative misattuned state and back again. This repair process allows an infant to actively cope with negatively charged affects. In the process of overcoming interactive stress, the infant gains self-regulatory skills.

AJP: Does this process advance beyond coping and the building of skills? Does it go beyond repair?

Schore: Yes. Classical attachment theory once held that attachment was primarily protective and aimed at reducing an infant's fear. It made little mention of positive affects such as joy, excitement, and surprise. Modern attachment theory notes that mothers cocreate a bond of emotional communication with infants by synchronizing with the rhythms of the infant's dynamic internal states. Attachment is thus fundamentally the communication and interactive regulation of emotion. The baby becomes attached to the psychobiologically attuned, regulating, primary care giver who not only minimizes negative affect but also maximizes opportunities for positive affect. Regulated interactions with a familiar, predictable, primary care giver create not only a sense of safety but also a positively charged curiosity that fuels the burgeoning self-exploration of novel socio-emotional and physical environments.

AJP: Is this where play comes in?

Schore: Play, in fact, is a fundamental expression of the attachment regulatory dynamic. Attachment is not just the reestablishment of security after a dysregulating experience and a stressful negative state. It is also the interactive amplification of positive affects, as in play states. Play calms and soothes infants, and it modulates their stressful states of negative arousal, replacing stress with intense joy and excitement. The dual regulatory processes of affect synchrony embedded in play states, and interactive repair, embedded in soothing and calming moments that modulate states of negative arousal, are the fundamental building blocks of attachment and its associated emotions. Synchrony and repair promote resilience and security.

AJP: Is play equally important in brain development?

Schore: Perhaps even more so. Attachment play imprints circuits during early critical periods of brain growth. We now have evidence that positive and negative affects activate different brain circuits. Play behavior transforms the physical environment into an enriched environment. Changes in cortical and subcortical synaptic development from exposure to enriched environments are associated with regulated, elevated levels of arousal. Mother-infant play, like all later forms of dyadic play, enhances behavioral flexibility through an increase in neural interconnectivity. And, in the first year of life, this enhanced plasticity occurs in the early developing nonverbal right brain, which develops before the verbal left.

AJP: What happens in this playful dialog between mother and child?

Schore: Although the mother and infant begin to monitor each other's face at the infant's birth, an increasing complex coconstructed communication system does not emerge between them for two or three months. During this same period, we see the onset of right brain-to-right brain protoconversations within the dyad. Colwyn Trevarthen notes that, in these initial transactions of primary intersubjectivity, a baby—attracted to her mother's voice, her gentle cooing, her reassuring facial expressions, and her gestures—replies spontaneously, affectionately, and playfully. In turn, a mother replies spontaneously and playfully to her baby's nonverbal communications. A traffic of visual, auditory-prosodic, and tactile signals pass between mother and infant that builds excitement and joyful pleasure, which the two express in facial expression, voice inflection, and body movements of posture and gesture. Infants note the sequence, rhythm, and pitch of the prosody (if not semantics) of the spoken word. Ellen Dissanayake also reports the emergence of increasingly animated mother-infant play at eight weeks associated with exaggerated facial expressions and utterances that is based on surprise and uncertainty. A creative mother's nonverbal communications thus expose the infant to spontaneous, interpersonal novelty, and this helps an infant integrate external and internal sensations.

The benefits of play at this stage extend beyond sensory integration and their effects propagate. During the first two or three months, mother-infant play experiences also help structure what Daniel Stern terms an unconscious core self. These spontaneous protoconversations of arousal-inducing play continue across the stages of infancy. Indeed, a major developmental task of an infant's first year increasingly involves more intense states of emotional arousal. And this system functions throughout the life-span.

AJP: Do you consider this an evolutionary purpose of play?

Schore: Mother-infant play over the first year serves an essential adaptive function—it progressively increases the infant's tolerance for higher and higher levels of arousal that sustains more complex emotional, cognitive, and behavioral emergent functions. This adaptive function evolves as a result of early maternal sensitivity to, participation in, and regulation of the infant's highly stimulated states. Mutual gaze is known to be a powerful amplifier of arousal. Stern characterizes the level of intensity of the joyful, excited infant as extremely high, creating maximum levels of activation almost

intolerable to the developing nervous system. He explains that joy arises from mutual regulation of social exchanges such as smiling, especially as it builds to giggling. Hilarity loves company, of course, as exuberant players pleasurably seek others with whom to share the fun.

AJP: How does play change the brain, and what does such change mean for growing infants?

Schore: Mother-infant play promotes human brain development during its initial two-year growth spurt, a period of right-brain dominance. The right hemisphere is centrally involved in face-to-face protoconversations, the recognition of emotional faces. Two months marks the onset of a critical period during which visual experience—including play experiences—modify synaptic connections in the developing occipital cortex, the same time in which infants show right hemispheric activation when exposed to a woman's face. Four-month-old infants presented with images of a female face gazing directly ahead show enhanced activity over right prefrontal areas. In these studies, at six months the infants showed a right-lateralized, left-gaze bias when they viewed a female face and significantly greater right-front temporal activation when they viewed their mothers' faces as opposed to the faces of strangers. Note the development in the first year of more complex visual-affective functions that allow infants to visually read their mothers' different affect states. We should take note of the development in the first year of more complex visual-affective functions that allow infants to visually read their mothers' different affect states.

We should remember that face-to-face, emotional communications, including those embedded in early mother-infant play, are more than visual. They also have a particular sound, expressed in the right brain prosodic emotional tone of the voice—"motherese"—that a mother uses in play. Indeed, the right hemisphere dominates the processing of prosody and rhythm. With respect to auditory communications, a magnetic resonance imaging study of one- to three-day-old newborns reports that lullabies evoke right hemispheric activation in their auditory cortices. Studies of the prosodic processing of emotional voices in three-month-old infants show activation of right temporoparietal region. Seven-month-old infants respond to emotional voices in a voice-sensitive region of their right superior temporal sulcus, and happy-sounding prosody specifically activates their right inferior frontal cortexes.

AJP: Given your attunement metaphor, does the emotive, musical tone of motherese play any specific role in brain development?

Schore: The emotional quality of what infants hear in the early stages of infancy affects the development of the voice-processing areas of the right hemisphere, especially the temporal voice areas in the upper banks of the right superior temporal sulcus. Studies note the importance not of the verbal content but of the melody of a mother's voice, and whether she uses infant-directed or adult-directed speech in her interactions with her child, especially in both arousal-amplifying, playful contexts and arousal-reducing, calming and soothing contexts. This use of infant-directed speech is thus essential to the development of an infant's right-temporal areas. The corresponding burgeoning ability to read the emotional tones of the voice of others becomes an essential element of all later social relationships.

AJP: We have covered sight and sound, so how does touch affect infant play?

Schore: Mothers and their babies use interpersonal touch to communicate and regulate emotional information. And mother-infant play provides a relational context for this body-based, affective communication. Clinical research has demonstrated the essential role of maternal affective touch on human development in a child's first year. This research shows an infant's need for affectionate touch for healthy right-hemisphere development. Two decades ago, Jechil Sieratzki described the effects of touch on the developing right hemisphere. He asserted that the emotional impact of touch is more direct and immediate if we cradle infants on the left side of our bodies. Later studies reported that mothers tended to touch their three-month-old infants' heads on their left cheeks. In the second year, as a securely attached infant becomes a toddler, his or her interactively regulated right brain-to-right brain visual-facial, auditory-prosodic, and tactile-gestural communications become more and more integrated, allowing for the emergence of a coherent, right-brain emotional and corporeal sense of self. How effectively this adaptive self-system alters its internal state depends upon changes in the external environment, which allows for flexible and resilient behaviors in response to personally meaningful stressors.

AJP: Does this process benefit only infants?

Schore: No. The psychobiological attachment dynamic is expressed in all later developmental stages. Researchers now assert that we are biologically connected to those with whom we have close relationships. Homeostatic regulation between members of a dyad is a stable aspect of all intimate

relationships throughout the life-span. In all ensuing periods of human development, attachment dynamics find expression in right brain-to-right brain communications of affect and the interactive regulation of affective arousal. The evolutionary mechanism of attachment is, fundamentally, the regulation of biological synchronicity between and within organisms. This mechanism occurs most prominently at later points of shared, spontaneous, improvised, and emotionally rewarding moments of intimate contact, including intersubjective play.

AJP: So players are like lovers?

Schore: Researchers note the similarity of mother-child play and interpersonal intimacy in the child's first year and in later development, especially in the right-brain, nonverbal facial, prosodic, and gestural expressions they share. Lovers speak to each other like parents speak to their young children. In both playful and intimate contexts, players and lovers will move close and in synchrony; they emphasize musicality over meaning, and, of course, they sometimes even employ baby talk.

AJP: Can you tell us more about early playful protoconversations?

Schore: Terry Marks-Tarlow points out that the right brain-to-right brain mother-infant protoconversation continues over the first year in play, songs, and chants such as peek-a-boo and "This Little Piggy." In this play, repetition in the mother's vocal utterances, facial expressions, and body movements coordinates the minds and brains of two bodies, regulating the infant emotionally and uniting mother and child temporally. Thus over the course of the first year, intersubjective play occurs in a relational context of mutual psychobiological regulation. Recent advances in developmental neuroscience and developmental psychology also clearly indicate that mother-infant play not only precedes but acts as a social-psychobiological crucible for later-forming solitary play. Interpersonal neurobiology suggests that mother-infant play is more socio-emotional than cognitive, and that, fundamentally, the underlying mechanism of this arousal-altering, pleasurable, rewarding activity facilitates the experience-dependent maturation of both the cortical and subcortical systems. This primordial form of play generates the neurobiological substrate on which all forms of play—mother-infant and solitary, spontaneous and controlled, active and passive—evolve.

At all points of the life-span, spontaneous play represents an emergent property of an interactively regulated, nonlinear dynamic system. In this relational context, play expands an infant's tolerance of higher and lower

states of arousal and broadens the regulatory boundaries and windows of arousal tolerance.

AJP: How does play entrain and elaborate the infant's emotional capacities?

Schore: During the first year, dyadic relational play expands the infant's affect array. The psychobiological mechanism embedded in mother-infant play allows the transformation of mildly pleasurable enjoyment into joy and the intensification of mildly pleasurable interest into excitement. In this context of regulated, accelerating, positive arousal, discrete affective states grow more complex. The relational context between a playful mother and her infant thus allows the infant's maturing brain to create an expanding variety of emotional states. In this early development of the self, the care givers initially regulate emotion; but over the course of infancy, it becomes increasingly self-regulated as a result of neurophysiological development. This expansion of auto-regulation allows more complex forms of solitary play.

Over the maturational course of infancy, the passive, immobile infant at the beginning of the first year becomes an active, upright, mobile being by its end. This structural development allows highly elevated levels of stimulation-seeking exploratory play generated by the mesocortical dopamine system to support locomotion and exploration. In other words, the enriched environment of intersubjective play during the first months is now accompanied by the enriched environment of the neo-toddler's full-body, active play. Indeed, at ten months, with the appearance of upright locomotion and the functional onset of the orbital prefrontal cortex, fully 90 percent of maternal physical and verbal behavior consists of affection, play, and care giving, and by one year of age, stimulation-seeking exploratory play time increases to as much as six hours of a child's day. These relational events represent the early origins of both passive and active play, and they are both influenced by a child's emotional transactions with—and regulated attachments to—a mother.

Research shows that at ten to thirteen-and-a-half months, a significant increase in positive emotion accompanies the neo-toddler's rapid neuromuscular development, gross motor ability, and upright locomotion. But as the second year progresses, the social environmental niche of the care giver–infant dyad changes dramatically. The process of socialization begins in earnest, and the mother's role shifts dramatically from mostly care giver to socialization agent. Soon after the onset of exuberant upright locomotion,

tion, parental socialization focuses on discipline in addition to nurturant functions. That being the case, as Russell Meares points out, in optimal attachment contexts, the right brain-to-right brain protoconversation continues in the second year, a time when a toddler becomes acutely aware of others, develops a full, playful imagination, and grows eager for novel experiences. With the expansion of higher right-brain functions and the onset of language, the intersubjective protoconversation now takes the form of intersubjective imaginative games, then intrasubjective, internalized dialogues, and then what Meares calls “conversational play.” This creative game, which a toddler plays while alone, depends on make-believe, the expressive use of words, and analogy.

It is similar to Jean Piaget’s symbolic play, but Meares describes it as analogical or protosymbolic play, which is imbued with the extra dimension of pleasure. The game consists of a miniature story, told as if to the child himself or herself but also to someone else, who is not there except as a feeling of the presence of the internalized, protoconversational mother. This earliest form of symbolic play allows the toddler to play with ideas and generate fantasies, including fantasied interactions with other selves. Studies now confirm that symbolic play and imagination are heavily influenced by right-brain activation and that both of these processes are inhibited by shame.

AJP: Shame?

Schore: Yes, a number of authors have emphasized the growth-facilitating importance of small doses of shame in the socializing the infant. In fact, this attachment emotion, which has been described as the primary social emotion, makes its initial appearance in the second year. Guided by the principle that all affects develop within an interpersonal context and that specific affects imply a particular form of relatedness, I proposed more than twenty-five years ago a prototypical model of shame based on an analysis of incipient shameful experiences. A toddler—in an activated, hyperstimulated, high-arousal state of stage-typical, ascendant excitement and elation—reattaches to a care giver as in late infancy. Despite an excited expectation of a psychobiologically attuned shared positive affect state with the mother and a dyadic amplification of the positive affects of excitement and joy, the infant unexpectedly encounters a facially expressed affective misattunement, an embarrassed or disgusted expression from the mother that triggers a sudden, shock-induced deflation and propels the infant into

an intense, low-arousal state the infant cannot regulate. Shame represents this rapid transition from a preexisting, high-arousal, positive, hedonic state to a low-arousal, negative, hedonic state. And, true, shame blocks the play state and acts as a brake on a developing child's desire to be constantly at the center of his or her parents' attention. The key is then the mother's interactive repair of shame.

AJP: We have talked about a mother's influence, but how does play with a father affect an infant's self-regulation and brain development?

Schore: A major transition in the middle of the second year involves male and female toddlers in more complex interactions with their fathers. We have long established that a father's play with an infant is more arousing than a mother's. Though a mother's soothing play is essential to a child's attachment security, a father's arousing play can be critical to a child's competent exploration of the physical world. I have suggested that not only an infant's mother but a toddler's father has an effect on the growth of a baby's brain. I have proposed that in the middle of the second year the structural development of a child's brain shifts from a maternal, experience-dependent maturation of an early developing right brain circuitry to a paternal experience-dependent maturation of later-developing, left-brain circuitry. Now a father becomes an important source of arousal induction and reduction, and his regulation of higher levels of stimulation influences the formation of the neural structures entering into a critical period of growth. Neuroimaging research demonstrates that although maternal care giving involves an evolutionarily ancient, subcortical-paralimbic network engaged in emotional processing, paternal care giving activates a later-developing cortical circuit involved in socio-cognitive understanding, mentalizing, and planning.

Researchers have shown that paternal care affects synaptic development in, for example, the somatosensory cortex of the left hemisphere. These studies indicate that paternal care significantly affects the development of play behavior, especially active, full-body play. Interestingly, Jaak Panksepp finds that juvenile rough-and-tumble play is critically affected by the father-child relationship. The father serves as a regulator of a toddler's increasingly expressed aggressive impulses (the "terrible twos"), and rough-and-tumble play (as opposed to the mother's earlier role in fear regulation). The eighteen-month-old toddler's increases in negativism ("no!"), an interpersonal behavior of noncompliance, is essential to the emergence

of autonomy and to the expression of the child's developing interpersonal influence strategies. Indeed, the parents' emotional responsiveness to this is critical to the development of autonomy.

This same period represents the end of a right-hemisphere growth spurt and a critical period of growth in the left hemisphere. From an interpersonal, neurobiological perspective, I have suggested that the paternal attachment system of father-toddler interactions forges imprints in the child's evolving left-brain circuits, including the left dorsolateral prefrontal cortex and the left motor systems controlling voluntary movement. Very recent models of brain laterality hold that—in contrast to the right hemisphere's role in affiliation, empathy, trust, and social intelligence—the left hemisphere's role lies in power, dominance, control of others, and autonomy. Ideally, these two motivational systems, their affiliation and power, are sufficiently expressed and balanced.

AJP: How does autonomy emerge?

Schore: Emotion is initially regulated by care givers, but over the course of the first two years it becomes increasingly self-regulated as a result of neurophysiological development. Secure, interactively regulated attachment histories are imprinted into developing, right cortical-subcortical circuits in implicit-procedural memory, thus generating an internal working model of attachment that encodes strategies of affect regulation, strategies that nonconsciously guide the individual through interpersonal contexts. Consisting of a dual processes of self-regulation, these adaptive strategies are interactive regulation (the ability to flexibly regulate psychobiological states of emotions with other humans in affiliative contexts) and autoregulation (which occurs apart from other humans in autonomous contexts). For the rest of the life-span, individuals under stress can down-regulate negative affect by turning to others for comfort or by engaging in private nonsocial activities. Similarly, they can share intense joy with others or experience it in a solitary state.

Parents often note that that their toddler's independence seems to signal their emerging personalities. In fact, depending on their interpersonal neurobiological attachment histories with their mothers and then their fathers, individual personalities (and genders) vary in the balance of the two mechanisms of self-regulation. Early social experiences of mutual intersubjective play of the developing mind and active physical play of the maturing body act as enriched environments for the creation of a flexible personality

that employs either interactive regulation or autoregulation. That said, these adaptive, regulatory mechanisms derive from our earliest attachments to other human beings, and they are both forged and strengthened in various affect-regulating attachment experiences including play experiences.

AJP: What happens when something goes wrong? How does trauma impact development?

Schore: Regulation theory offers a comprehensive interpersonal neurobiological model for the development, psychopathogenesis, and treatment of the subjective self. Over the last three decades, I have used the interdisciplinary perspective of the theory to integrate data from developmental psychology, developmental neuroscience, developmental psychopathology, and child psychiatry to offer heuristic and clinically relevant models of psychopathogenesis. The contrast between the kind of optimal growth-facilitating attachment I have described and the relational, growth-inhibiting, early environment of attachment trauma that involves abuse and neglect (or both) is a stark one. In abuse or neglect, a primary care giver induces traumatic states of enduring negative affect—of intense, overwhelming, fear or sense of loss—in an insecure disorganized, disoriented infant. Such care givers are misattuned and emotionally inaccessible and react inconsistently and inappropriately to their infants' expressions of stress with massive intrusiveness or utter disengagement. They therefore participate minimally or unpredictably in relational arousal-regulating processes, including intersubjective play. Instead of modulating these extreme levels of stress, they induce them. Because they provide little interactive repair, their intense negative affective states of stimulation and arousal—very high in cases of abuse, very low in cases of neglect—become long lasting. For an immature organism with undeveloped and restricted coping capacities, the primary care giver is the major source of stress regulation and, therefore, a sense of safety. When danger instead of safety emanates from the attachment relationship, the homeostatic assaults have significant short- and long-term consequences on the maturing psyche and soma.

AJP: What consequences?

Schore: During these episodes of imprinted right brain-to-right brain relational trauma, a child matches the rhythmic structures of a mother's dysregulated states, and this synchronization registers in the firing patterns of the stress-sensitive cortical and limbic regions of an infant's brain, especially in the right brain, which is in a critical period of growth. The detrimental

psychobiological impact of this intergenerational transmission of relational trauma is the altered metabolic processes that poorly sustain the critical period of growth of the developing right brain. Early attachment trauma (common in psychiatric and severe personality and psychiatric disorders such as borderline personality) imprints a permanent physiological reactivity of the right brain and a susceptibility to later disorders of affect regulation. This mechanism of frequently ruptured attachments and poor interactive repair generates a lasting impairment—an inefficient and limited ability of the right brain to regulate the stressors that later in life generate intense emotional states, both negative (affects such as fear, sadness, and shame) but also positive (affects such as excitement and joy). When under stress, such personalities avoid turning to others for interactive regulation. Instead, they disengage from the social environment and rapidly enter into a state of defensive dissociative autoregulation. The inability to cope with emotional and social stressors finds expression in a lowered threshold for emotional turbulence, an increased tendency for defensive dissociation that blunts both negative and positive affect, and a hyperreactivity to novel events.

AJP: What kind of impact does such stress have on play?

Schore: The intense and enduring stress that arises in such psychopathogenic social-emotional contexts is associated with histories of significantly reduced amounts of spontaneous play. In early right-brain attachment trauma, the chronically dysregulated self does not seek but avoids spontaneously generated interpersonal novelty, a component of the protoconversation of mother-infant play. As I have already mentioned, early relational play imprints right-brain circuits, especially dopaminergic circuits in their critical period of maturation during the first two years. Neglect and abuse interfere with the experience-dependent maturation of right-lateralized reward circuits as well as with the connections between the central and autonomic nervous systems. In this manner, the neural substrates of early protoconversational, intersubjective play, and later symbolic play fail to evolve, leading to enduring deficits in these adaptive, growth-promoting functions.

AJP: Have your therapy models changed in light of these insights?

Schore: Attachment trauma, inscribed not in left-brain, verbally explicit memory but in right-brain, nonverbally implicit memory, has become a central focus of developmentally oriented, emotionally focused psychotherapy—mine

and others—with children and adults. Psychotherapy with such patients attends to the severe dysregulation of affect as well as to the interpersonal and intrapsychic deficits that characterize the developmental self-pathologies associated with histories of relational trauma. In light of the commonality of nonverbal, intersubjective, implicit right brain-to-right brain, emotion-transacting, and regulating mechanisms in the care giver to infant and the therapist to patient relationship, developmental attachment studies have direct relevance to the treatment process.

Thus regulation theory is particularly relevant to therapy in cases of relational trauma. It provides an interpersonal, neurobiological model for the psychotherapeutic context. During treatment, an empathic therapist consciously and explicitly attends to a patient's verbalizations to diagnose and rationalize his or her dysregulating symptomatology. But an experienced therapist also listens and interacts at another, more subjective level, one that implicitly processes moment-to-moment, social-emotional information at levels below awareness. Beneath the conscious verbal conversation of two left brains is the unconscious nonverbal protoconversation of two right brains. For a therapeutic alliance to work, a therapist must be felt by the patient to be in a state of vitalizing attunement. In other words, the crescendos and decrescendos of a therapist's affective state must resonate with a patient's similar state. An intuitively empathic therapist psychobiologically attunes to and resonates with a patient's shifting affective state, thereby cocreating with the patient a context in which the clinician can act as a regulator of the patient's physiology.

Recently, I have suggested that the right hemisphere dominates psychotherapy. Experiences of relational trauma and attachment dysregulation appear in the therapeutic alliance as clinical reenactments. From a neuropsychological perspective, rapid, implicit right brain-to-right brain nonverbal body-based, affective communications (facial expressions, tones of voice, and gestures) convey unconscious transference-countertransference transactions, which revive earlier attachment memories, especially of intensely dysregulated affective states. Russell Meares has also described a form of therapeutic conversation that can be conceived as a dynamic interplay between two right hemispheres. As in early development, the attachment dynamic of interactive repair and regulation of the patient's dysregulated affects are an essential mechanism of the therapeutic action.

AJP: From your perspective, what is the role of play in psychotherapy?

Schore: With respect to child psychotherapy, clinical models of play between therapist and patient have long been known to be effective with early trauma histories. According to the Association for Play Therapy, treatment involves “the systematic use of a theoretical model to establish an interpersonal process wherein trained play therapists use the therapeutic powers of play to help clients prevent or resolve psychosocial difficulties and achieve optimal growth and development.” Studies of neurobiologically informed play therapy now integrate data from neuroscience and recent advances in theory, including my own work on attachment, attunement, and the right brain. These approaches focus on attachment trauma and stress the importance of the therapeutic relationship and the regulation of affective states. The paradigm shift I mentioned earlier now indicates that the role of the therapist is not to interpret children’s play, but to cocreate play contexts that can form an attachment, a bond of emotional communication and interactive regulation. We understand a child’s defenses as strategies that minimize or avoid intolerable affects, and so we pay attention not only to conscious but also to unconscious affects.

AJP: Are you implying that the therapist needs to become a playmate?

Schore: In this sense: Spontaneous (more so than controlled) dyadic play can reenact attachment trauma, which is then communicated and regulated by the therapist. Play therapy also serves as a context for rupture and repair, which enables a child to cope with an array of negative affects and to generate novel solutions to interpersonal problems. The cocreated therapeutic relationship thus allows children to tolerate and regulate not only negative emotions but also positive emotions, and it offers a more secure implicit, positive sense of self and emotional well-being.

AJP: Does this also have implications for therapy with adults?

Schore: The integration of neuroscience into clinical models instills an appreciation of the essential role of play in the “change process” of adult psychotherapy. For example, current neurobiologically informed models of music therapy—and dance and movement therapy and art therapy—now incorporate my work. But beyond these, traditional psychotherapists are also emphasizing the growth-facilitating effects of play. Let me paraphrase Winnicott’s classical dictum: Psychotherapy happens in the overlap of the two play areas—that of the patient and that of the therapist. He said that, if the therapist can’t play, he’s not suitable for the work; and if a patient can’t play, then something needs to be done to enable the patient to play—and

after that, psychotherapy can begin. The reason playing was so essential, according to Winnicott, was that by playing a patient was being creative.

With adults, therapy focuses on interactively regulating conscious and unconscious negative and positive affect, as well as facilitating the growth of the patient's symbolic, imaginative functions. Play allows the patient and therapist not only to discover but to nurture different and more complex aspects of the right-brain self. That said, in all forms of psychotherapy—infant, child, and adult—many now agree that the emotion expressing and regulating attachment relationship between the patient and therapist is essential to therapeutic change.

This kind of therapy goes substantially beyond teaching patients coping skills. The practice of psychotherapy is fundamentally relational. The therapeutic alliance—the major vector of change—is essentially a two-person system for self-exploration and relational healing. At all points in the life-span, this emotional growth of the self occurs in relational contexts. From infancy throughout life, spontaneous, rapidly acting emotional processes are centrally involved in enabling us to regulate—and, thereby, to cope with—stresses and challenges. These processes are thus an essential marker of mental health and emotional well-being.

AJP: If play changes the brain, should we assume that psychotherapy also changes the brain?

Schore: The way patients grow proves to be more than psychological. A large body of research indicates that therapy induces neuroplastic changes in the brain, especially in the emotion-processing right limbic system. The early developing right brain has later growth spurts. Psychotherapy-induced changes in the right brain allow the transformation of an insecure attachment into an “earned secure” attachment that encodes more efficient strategies of affect regulation. Researchers have concluded that although the left hemisphere specializes in coping with predictable representations and strategies, the right predominates in assimilating novel situations and interacting with a new environment. In addition to promoting cognitive changes, psychotherapy can boost emotional resilience, a central marker of mental health, which we consider an individual's ability to use in coping flexibly with the surprises and stresses inherent in human interactions.

AJP: Many consider surprise to be a key element of play. Does it also help psychotherapy?

Schore: Recall that attuned play amplifies joy, excitement, and yes indeed, sur-

prise. A positive state in turn allows individuals to experience a situation as safe, to feel unrestrained, to take risks, to explore novel pathways, and to be creative. I've suggested that the positive arousal of surprise is central to all forms of exploration and play and is associated with increasing safety and trust. Psychoanalyst Philip Bromberg has written extensively about the critical role of "safe surprises" in therapy, calling it "interpersonal novelty" that allows the self to grow because neither party anticipates it. Instead, he claims, it is organized by what takes place between two minds and belongs to neither alone. He concludes that through the novelty and surprise of this reciprocal process therapeutic action takes shape, and they account for the enhanced spontaneity and flexibility of a patient's personality resulting from successful therapy.

AJP: What new technologies have had an impact on your work?

Schore: For much of the last century, we based our knowledge about brain functions on anatomical studies of neurological patients, which excluded research on normal brains. EEG accessed only cerebral levels, offered poor resolution within cortical regions, and provided no access at all to subcortical areas. Then came the so-called "the decade of the brain" in the 1990s, and researchers began using neuroimaging technologies such as functional magnetic resonance (fMRI), technologies that could record with more local precision brain activity as it moves from a resting to an activated state during various human functions, both pathological and normal. We now have studies in real-time of brain changes during not only cognitive and emotional functions but also during higher functions involving creativity, morality, and humor. In addition, these technologies reach deep subcortical brain structures like the amygdala, hypothalamus, and brain stem. Recent neuroimaging studies of the central nervous system, along with updated measures of the autonomic nervous system, have greatly added to our knowledge of the mechanisms that lie beneath behavior, cognition, and affect.

Technological advances have enabled a major area of current research focusing on brain laterality. There is now agreement that each hemisphere is an independent system capable of different forms of attention and different forms of consciousness. Indeed, the differences between the two hemispheres are profound. Thus we are using the current concept of hemisphericity to explore and understand not two halves of one brain, but dual right and left cortical-subcortical systems with unique structure-

function relationships. In other words, the singular term “the brain” is imprecise—we’re looking at a dual system.

Neuroimaging research has established that the right hemisphere is critical to the processing of social and emotional information such as facial recognition and deciphering nonverbal communication. These, of course, are central components of the attachment dynamic and face-to-face play. Facial emotions can be automatically appraised by the right brain at astonishing speed—within thirty milliseconds—and then spontaneously expressed a fraction of a second later. Advances in technology allow us to understand better very rapid spontaneous processes that occur beneath levels of conscious awareness. Attachment relationships shape circuits in the right brain during early and critical periods of right-brain development.

AJP: Then are we the sum of our brain’s early circuitry?

Schore: The story is more complicated. Adaptive attachment mechanisms endure over the course of the life-span. Again, the right brain has later growth spurts affected by social emotional experiences. Throughout life, the right brain, and not the left brain, is critical to survival functions such as the allocation of attention, the capacity to experience positive and negative emotions, the regulation of stress, and the ability to read the emotional states of other human beings empathically and intuitively. The right hemisphere specializes in pattern recognition—in the comprehension of faces, chords and complex pitch, graphic images, and voices. Over the life-span, the right lateralized prefrontal regions are responsible for the most complex regulation of affect and stress. Indeed, the right frontal cortex, more closely in touch with emotion and the body, is also the most sophisticated, extensive, and highly evolved part of the brain. Its basic, social, perceptual, and regulatory functions are the foundations of later evolving higher human functions. Self-awareness and empathy depend on the circuits in the right hemisphere. And there, too, resides our ability to resolve social conflict. We perceive voices, sense smells and interpret pheromones, recognize faces, and interpret gestures on the right side. All these abilities play a role in interpersonal competence.

But recall that interpersonal neurobiology attempts to understand how the structure and function of the brain are shaped by experiences, especially those involving early emotional relationships. This perspective also attempts to understand how brains align their neural activities in social interactions. My work in developmental neurobiology specifically focuses

on how the early developing right brain, the “emotional brain,” is indelibly affected by emotional attachment relationships. But the right brain is also impacted by later emotional attachments—close relationships, including deep friendships and mutual love.

AJP: Let’s return to the revolt against behavioral psychology. How does your new understanding of the right brain better equip us to understand the fast-acting neurodynamics of how we relate to others?

Schore: We can also see the paradigm shift from behavior to cognition to emotion in recent attachment research promoted by affective and social neuroscience, which is moving from the left to the right brain. Developmental neuroscience has moved beyond producing semantic, abstract studies of the attachment verbal narrative into real time, ecologically valid studies of a mother’s responsiveness. And they measure her response not to simple static images of generic infant faces but to videos of her right-brain, dynamic, emotional reactions to her own infant. In parallel, neuroscientists are also beginning to study an infant’s right-brain responses to videos of his or her mother. The next step is to measure changes in both synchronizing brains and bodies as they align, synchronize, and emotionally interact. In other words, moment-to-moment dynamic right-brain-to right brain measures. We are moving from a one-brain neuroscience to a two-body and two-psychology understanding. A recent study of simultaneous fMRI brain images on both participants of a pair reports that establishing mutual understanding of novel signals synchronizes cerebral dynamics across the communicators’ right temporal lobes. The interpersonal cerebral coherence occurred only in pairs with a shared communicative history. Not incidentally, this two-person psychology could also lead to a breakthrough in studying and understanding people involved in an intimate therapy relationship, or a loving couple, or indeed of free play between familiar individuals within a close friendship.

AJP: How has the new understanding of the right brain advanced neuropsychology?

Schore: The neuroscience research on the nonverbal, fast-acting, implicit, nonconscious functions of the right brain has also affected the growth of neuropsychology—the study of the interpersonal neurobiological development of the unconscious mind. Iain McGilchrist, an authority on brain laterality, has noted that traditionally the right hemisphere has been “shrouded in darkness,” silent, and, as he put it, “dumb.” But recent neuro-

science has shined light on this implicit realm of the human experience. We now have access to efficient, fundamental, ultrafast processes and rapid spontaneous phenomena that occur before and beneath conscious awareness. The right amygdala, the major fear center in the brain, for example, processes a facially expressed threat stimulus in well under one hundred milliseconds. It takes another four hundred milliseconds for the individual to be consciously aware of threats.

And we are this fast at grasping the nuances of complex social situations. The right prefrontal insula and anterior cingulate relay a fast intuitive assessment of complex social situations to allow the rapid adjustment of behavior in quickly changing and therefore uncertain social situations. Intuition, a knowledge that bypasses conscious reasoning, clearly implies right-brain, not left-brain, processing. Current brain research on human decision making articulates dual-process theories that clearly differentiate right hemispheric intuition—which is fast, emotional, effortless, and creative—from left hemispheric reasoning, which is slow, controlled, and effortful. We now conceptualize intuition as subjective experience associated with the use of knowledge gained through implicit learning and as direct knowing that seeps into conscious awareness without the conscious mediation of logic or rational process. Furthermore, by structurally locating circuits activated at various levels of implicit, unconscious process, neuropsychology has allowed us to explore the distinct dynamic of the preconscious, unconscious, and deep unconscious right-brain functions.

AJP: This seems to return us to Freud's quest for a biology of the mind.

Schore: Indeed, yes it does. For the last three decades, I have offered research and clinical studies that support the idea that the essential functions of Freud's unconscious mind are localized in the right brain, the subjective implicit self. Freud distinguished early-forming, unconscious, primary-process, nonverbal language functions from later-forming, conscious, secondary-process language functions. There is now agreement that verbal, conscious, rational, and serial information processing takes place in the left hemisphere, whereas nonverbal, unconscious, holistic, and subjective emotional information processing takes place in the right. Freud was correct in positing that the deep unconscious (right) mind, which is highly visual, develops before the conscious surface (left) mind. We can now equate the early development of the unconscious with the ontogenesis of a self-system that operates beneath conscious verbal levels.

Again, McGilchrist has marshaled a large body of evidence that indicates the right and left hemispheres create coherent, utterly different, and often incompatible versions of the world. And these world views establish competing priorities and values. He says that the conscious mind brings the world into focus and allows us to formulate thoughts in language. And crucially, he points out that the left brain is “aware of its own awareness.” The left hemisphere also depends on denotative language and abstraction to manipulate what is known, fixed, static, isolated, decontextualized, explicit, disembodied, and general. But for all its remarkable command, the power of the left brain extends only so far. McGilchrist notes that these static, decontextualized facts, the province of the left brain, are ultimately lifeless.

In fact we owe our appreciation of the lived world to the right hemisphere. In contrast to the left hemisphere, the right generates a world that consists of changing, evolving, interconnected, living individuals. The sense of the shifting social world often eludes our grasp; we know it only imperfectly, but it cares for us and gives us our lives. Naturally, the relationship between the two hemispheres is not always easy or harmonious. McGilchrist explores this tension in *The Master and His Emissary* [2009]. Alluding to Nietzsche’s allegory, he portrays the right hemisphere as the Master. The left brain, the willful Emissary, seeks power, believes itself superior, and—in its ambition—sometimes betrays the Master, bringing both to harm. In his cautionary tale McGilchrist convincingly argues that the left hemisphere increasingly takes precedence in the modern world, with potentially disastrous consequences.

I agree that present-day Western culture, even more so than in the past, overemphasizes left-brain functions. Our cultural conceptions of both mental and physical health, as well as the aims of all levels of education, continue to stress rational, logical, analytical thinking at the expense of holistic, body-based, relational, right-brain functions essential to homeostasis and survival. I would add that we see this trend in the current devaluation of spontaneous free play and the overemphasis on controlled, highly structured play. This left-hemispheric bias also overvalues active bodily exercise over mental activities and, thus, devalues playing with ideas and fantasy. And as we undervalue the symbolic play associated with the right brain, we diminish the unique powers of imagination, frustrate innovation, and starve the creative arts.

AJP: Could you summarize the ways that regulation theory guided your work?

Schore: In 1994 I first articulated the basic organizing principles of regulation theory, and over the last three decades, I have expanded the theory. Note that what I am offering is a theory, a systematic exposition of the general principles of this science. I continue to argue that no theory of any human function can be restricted to a description of psychological processes. During that time, I continued to articulate three principles: First, that developmental theory must extend across the life-span. Second, that it must integrate psychology and biology consonant with what we now know about biological structure and brain development. And third, that it must account for unconscious systems in everyday life that operate beneath awareness. The test of this theory is its success in generating testable hypotheses that yield experimental research that can be applied clinically.

I then applied the lens of regulation theory to different aspects of the human experience. In my second and third books, *Affect Dysregulation and Disorders of the Self*, and *Affect Regulation and the Repair of the Self* [both published in 2003], I focused on the problem of trauma, early brain development, psychopathogenesis, and affect dysregulation, as well as on the underlying right brain mechanisms involved in trauma that are reexpressed and repaired in affectively focused psychotherapy. In a subsequent volume *The Science of the Art of Psychotherapy* [2012], I cited recent advances in neuroscience to support a new paradigm of psychotherapy that emphasized the essential role of both conscious and unconscious affects in treatment. I then outlined a clinical model of therapeutic enactments of relational trauma that can alter right-brain circuits and allow psychotherapeutic changes in both the left and the right brain. I also applied the theory to pediatrics, psychiatry, family law and other cultural phenomena, and ethology when I investigated trauma in another big-brained mammal, elephants!

AJP: Where are you headed next?

Schore: I am now focusing on four other problems: the early interpersonal neurobiological origins of autistic spectrum disorders, and the subjects of gender, love, and creativity. Let me take these one at a time and begin with autism. All mental health fields now agree that infantile autism and disorganized insecure attachments are the most severe clinical expressions of early dysregulated social and emotional human development. A growing body of studies shows altered right-brain maturation in these developmental psychopathologies. This has highlighted the need for a more effective

neurobiologically informed model of differential diagnosis between these two disorders in infancy. Indeed, there is a strong if not urgent call in both autism and attachment literatures for updated, research-informed, clinically relevant interventions that can more effectively assess the mother-infant dyad during early periods of brain plasticity.

In 2013 I was approached by the editor of the *Journal of Infant, Child, and Adolescent Psychotherapy* to offer a neurobiological commentary on an upcoming article reporting the successful treatment of an attachment disorder over the first year. Citing both the infant-attachment and autism literatures, the author specifically posed the problem of differential diagnosis, a problem commonly encountered by clinicians who specialize in infancy. In response, I published two articles on the early interpersonal neurobiological assessment of attachment and autistic-spectrum disorders. Studies indicate that the psychopathological processes leading to autism begin during fetal development due to untoward intrauterine influences of the social and physical environment, while disorganized attachments result from epigenetic mechanisms associated with stressful perinatal and postnatal social environments. The complex neurodevelopmental autistic disorders reflect altered connectivity and developmental derangement of the right brain, as opposed to attachment disorders that represent delayed connectivity or immaturity of the limbic-autonomic circuits of the right brain. Although both the analytic left hemisphere and holistic right hemisphere are affected by a common neuropathological process, at the core autism represents a severe impairment of the right-lateralized, implicit, cortical-subcortical self system that acts unconsciously and automatically.

AJP: Does play have a role in this work as well?

Schore: Yes. Deficits in later developing pretend play are well documented, but I argue that deficits in the early spontaneous mother-infant play of proto-conversation and intersubjectivity are central to the psychopathogenesis of autistic disorders. I have used neuroscience data to formulate an assessment model of a mother's right brain, an infant's right brain, and a mutually constructed right brain-to-right brain attachment relationship. Early assessments of high-risk dyads can easily transition into clinical interventions that potentially expand a mother's implicit capacities for interactive affect regulation—the core of the attachment dynamic—thereby creating a growth-facilitating environment for infant right-brain development. This work suggests that modern attachment theory can act as a catalyst for the

cross-fertilization of the attachment and autism worlds, one that can lead to more effective clinical intervention models. It also highlights the need for early prevention, including in the prenatal period.

And more recently, I have discussed the role of gender-differences in autism. In my latest developmental writings in the *Infant Mental Health Journal*—“All Our Sons: The Developmental Neurobiology and Neuroendocrinology of Boys at Risk” [2017]—I offer a large body of research that indicates boys, more than girls, are at risk for to autism, early-onset schizophrenia, ADHD, conduct disorders, and externalizing psychopathologies. These disorders have increased significantly in recent years. To understand why boys are at risk, I use regulation theory as a model of the deeper psychoneurobiological mechanisms that underlie the vulnerability of the developing male. My central thesis posits that significant gender differences appear between male and female social and emotional functions in the earliest stages of development and that these differences result from not only different sex hormones and social experiences but also in the rates of male and female brain maturation, specifically in the early developing right brain. Interdisciplinary research indicates that the stress-regulating circuits of the male brain mature more slowly than the female in the prenatal, perinatal, and postnatal critical periods, and that this dissimilarity is reflected in normal gender differences in attachment functions.

Because of maturational delay, developing males become more vulnerable over a longer period of time to stressors in the social environment—attachment trauma for example, as well as toxins in the physical environment, including endocrine disruptors such as pesticides and plasticizers that impair right-brain development. In gender-related psychopathology, the early developmental neuroendocrinological and neurobiological mechanisms are involved in the increased vulnerability of males to the disorders I have mentioned, and they contribute to the recent widespread increase of these disorders in the United States.

AJP: You said that currently you are also looking at love and creativity. Does regulation theory and neuropsychanalysis offer insights in the age-old preoccupations of artists and poets?

Schore: I am indeed turning my attention to a different interdisciplinary interface, the integration of neuroscience and the humanities. I stood on the shoulders of two giants in the history of science, Darwin and Freud, in a recent paper “The Development of the Right Brain across the Life-Span:

What's Love Got to do With It?" Although love is mostly thought to be the province of the arts, of poets and writers, actors, dancers, and musicians, from the very beginnings of modern biology and psychology, science has also explored love's origins and emotional expressions. Indeed, in a work far ahead of its time, *The Expression of Emotions in Man and Animals* [1872], Charles Darwin noted that the power and the pleasurable sensation of love "causes a gentle smile and some brightening of the eyes" and "a strong desire to touch." Specifically referring to the origins of perhaps this most essential expression of the human species, he speculated, "The movements of expressions in the face and body . . . serve as the first means of communication between the mother and her infant; she smiles approval and thus encourages her child on the right path or frowns disapproval." At the beginning of the twentieth century, Sigmund Freud began his pioneering studies in psychoanalysis and initiated the field's long history of interest in the essential role of love in human function and dysfunction. Referring to his evolving position on the developmental origins of love, I've suggested that, although for much of his career Freud seemed ambivalent about the role of maternal influences in early development, in his very last work, he definitively stated 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."

AJP: So what does love have to do with attachment theory?

Schore: Let's define the terms first. Love can be a noun denoting deep affection or a verb, to love, that describes the feeling of tenderness and passion that one lover communicates to another. The contrast in these two usages mirrors the ongoing shift from a one-person, intrapsychic to a two-person, interpersonal perspective in psychology, including the most prominent theory in developmental psychology, attachment theory. I used data from neuroscience to shed light on the ability of humans to love one another. The paradigmatic expression of this strongest of all emotions is forged in an attachment bond of mutual love between a mother and her infant and this right brain-to-right brain, growth-promoting, emotional experience acts as a relational matrix for the emergence of the capacity to share a loving relationship with a valued other at later stages of life.

Consonant with Darwin's description of love as an emotional communication system, love is embedded in a basic evolutionary mechanism located in the early developing emotion-processing right brain. The mutual love

between the mother and the infant can optimally shape this evolutionary process. Neuroscientist Jack Nitschke and his colleagues [in a 2004 article for *Neuroimage*] assume that the first expression of love, the one between a mother and her infant, represents one of the “most powerful and evolutionarily preserved forms of positive affect in the emotional landscape of human behavior.” As such, love proves essential for the preservation of the human species.

A significant body of neuroimaging research on love in infancy and adulthood points to how right-brain attachment underpins the psycho-neurobiological mechanisms of the capacity to form and maintain a strong emotional bond of mutual love with a valued other. Recent neuroimaging research of mother-infant love offer a model of the initial emergence of mutual love at two to three months, the period of the onset of protoconvergence and dyadic play, as well as the neurodynamics of adult love. In a final section, “The Right Brain and Mutual Love across the Life Span,” I integrate the research and clinical data to model the neuroanatomy, neuropsychology, and neuropsychanalysis of this essential marker of what it means to be human.

AJP: Can love teach us more about the brain?

Schore: One of the major findings of brain science is that many of the underlying biological processes involved in mutual love operate at rapid time frames—and so unconsciously and at levels beneath awareness. For this reason, the relational psychobiological mechanism that underlies mutual love can best be described by integrating observations and data from not only neurobiology but also neuropsychanalysis. It is now established that the unconscious processing of emotional information is mainly subsumed by a right hemisphere subcortical route. From the earliest stages of development, the adaptive capacity to receive and express the intense, body-based signals of mutual love operates spontaneously. In other words, at all later stages, the interpersonal signals of love are first perceptually processed unconsciously, automatically, effortlessly, at levels beneath conscious awareness, and they trigger changes in emotional arousal and internal state that produce the neuroendocrine chemistry of mutual love.

AJP: And what’s play got to do with it?

Schore: This conception clearly suggests that intimate, spontaneous, intersubjective mother-infant play represents an important expression of mutual love. In fact this idea is a central theme of another soon to be published

work, “Early Right Brain Development: How Love Opens Creativity, Play, and the Arts” that I’ve written with Terry Marks-Tarlow, the guest editor of this issue of the *American Journal of Play* [see *Playground Creativity in Psychotherapy*].

AJP: That leads us to the final new subject you mentioned interested you—creativity.

Schore: As I have said throughout this interview, creativity has long been very meaningful to me, both personally and professionally. A large body of research implicates the right brain in creative processes, especially in the earliest stages where information is processed rapidly beneath conscious awareness. Indeed, research demonstrates that the initiatory stage of creative inspiration where sensorial, affective, and cognitive intergrations take place rapidly at unconscious levels, as well as the ensuing stage of “incubation” and the emergence into consciousness of sudden insight, are both right lateralized. Neuroscientists Naama Mayseless and Simone G. Shamay-Tsoory offer evidence that the right frontal area mediates creativity while the left competes with or interferes with an original creative response. They suggest an antidote to this inhibition of the conscious mind and a surer route to creative production: reduce left frontal activity and surrender some cognitive control; open the right hemisphere to ambiguity and novelty, the source of creativity and imagination, and, thereby, to poetry, art, and music. To this I would add play, an essential process in artistic and scientific creativity.

Neuroscientists are converging on the principle that creativity helps us adapt to changing circumstances, develop novel solutions to problems (including interpersonal problems), and give value and purpose to human experience. Creativity, now considered a personality attribute, enables us the flexibly to cope with the social and emotional challenges to the right-brain, integrated self at different stages of life and in changing cultural circumstances. This interpersonal neurobiological mechanism thus facilitates the growth and development of the social-emotional right brain, the human unconscious, throughout life.

The period of independent study I talked about earlier revealed that the process of both objective and subjective learning is a highly emotional one, and that studying body-based emotional processes cannot be done without also introspecting into my own self.

In essence a central aspect of my recent work is an attempt to use my self

reflective awareness in order to understand my own creativity, not just it's output, but it's organizational processes. In neuropsychanalytic terminology these contributions are efforts of my left brain to understand my right brain, of making conscious what is unconscious. I'm reminded of Jung's dictum, "Man's task is to become conscious of the contents that process upward from the unconscious." In this lifelong search Einstein tells us that "intellectual growth should commence at birth and cease only at death," and that "the true sign of intelligence is not knowledge but imagination."