The Neurobiology of Attachment and Early Personality Organization

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Full Text: Headnote ABSTRACT: Current advances in the developmental and neurobiological sciences are now being integrated into complex models of the development of self, and therefore personality. The human brain growth spurt, which begins in the last quarter of pregnancy and extends into the second year, overlaps the prenatal, perinatal, and postnatal periods. It also represents the early critical period for the experience-dependent maturation of the right hemisphere, which is dominant for processing socioemotional and bodily information, stress coping functions, and self-regulation. Interactively regulated psychobiological transactions between the infant and primary caregiver, embedded in the attachment relationship, are thus essential for the optimal development of self-regulatory functions and the organization of a personality with resilient coping functions. INTRODUCTION At this point in time, although "the decade of the brain" has ended, it is clear that we are in the midst of a remarkable period in which dramatic new brain technologies continue to concentrate their focus upon certain basic problems of the human condition. Current brain imaging studies of adults are now beginning to shift focus from neurology, to psychiatry, and now to psychological studies of the normal brain. This research is moving into the study of individual differences and personality. At the same time developmental neuroscience is beginning to explore the early origins of personality. I want to suggest that very recent findings in neuroscience, which integrate nicely with current attachment theory, the dominant model of social-emotional development available to science, can offer us more powerful models of how events influencing early brain development indelibly shape the origin of the personality, the self. In a 1991 article in the American Psychologist entitled "An ethological approach to personality development," John Bowlby and Mary Main argued that attachment theory is fundamentally a theory of the development of the personality over the life span. The Oxford dictionary defines self as "A person's individuality or essence at a particular time or in a particular aspect; a person's nature, character, or physical constitution." For some time psychology and psychiatry have assumed that the origins of personality trace back to early childhood. Current developmental brain research not only strongly supports this notion, it deepens our understanding of the mechanisms that underlie adaptive self functions. The question of why the early events of life have such an inordinate influence on literally everything that follows is one of the fundamental problems of science. How do early experiences, especially emotionally or "affectively" charged experiences with other humans, induce and organize the patterns of structural growth that result in the expanding functional capacities of a developing individual? We now know that the concept of "early experiences" connotes much more than an immature individual being a passive recipient of environmental stimulation. Rather, these events represent active transactions between the infant and the early environment. The most important aspect of the environment is the social environment, the relationship the infant has with its caregivers. These early socioemotional events are imprinted into the biological structures that are maturing during the early brain growth spurt, and therefore have long enduring effects. The stupendous growth rate in the first year is reflected in the increase of brain weight from 400g at birth to over 1000g at 12 months. The human brain growth spurt, which begins in the third trimester in utero and is at least 5/6 postnatal, continues to about 18 to 24 months of age. Notice that the growth spurt overlaps the prenatal, perinatal, and postnatal periods. It is now clear that during critical periods within the growth spurt the genetic specification of neuronal structure is not sufficient for an optimally functional nervous system-the environment also powerfully affects the structure of the brain. This "environment" is initially "internal," one biologically co-created in utero by the fetus and mother. Recent research indicates that maternal hormones regulate the expression of genes in the fetal brain, and that

acute changes in maternal hormone induce changes in gene expression in the fetal brain that are retained when it reaches adulthood (Dowling, Martz, Leonard &Zoeller, 2000). But later, in postnatal periods, the "environment" is co-created by psychobiological transactions between the neonate and the mother. Thus, both prenatally and postnatally, development represents an experiential shaping of genetic potential; genetically programmed "innate" structural systems require particular forms of environmental input. The traditional assumption was that the environment determines only the psychological residuals of development, such as memories and habits, while brain anatomy matures on its fixed ontogenetic calendar. Environmental experience is now recognized to be critical to the differentiation of brain tissue itself. "Nature's potential can be realized only as it is enabled by nurture" (Cicchetti &Tucker, 1994, p. 538, my italics). It has even been suggested that, "within limits, during normal development a biologically different brain may be formed given the mutual influence of maturation of the infant's nervous system and the mothering repertory of the caregiver" (Connelly &Prechtl, 1981, p. 212). Indeed, neurobiology has now established that the infant brain "is designed to be molded by the environment it encounters." Recent psychoneurobiological conceptions of development are modeling precisely how early social communications and emotional experiences influence the maturation of biological structure, which in turn organizes more complex emergent function. This integrative perspective is expressed in the concept of "experience-dependent" brain maturation. The period of the brain growth spurt contains the very early stages of infancy studied by attachment researchers. The development of the child's attachment outcome (and the early genesis of personality) is thus a product of the child's genetically encoded biological (temperamental) predisposition and the particular caregiver affective-relational environment. In his classic volume Attachment Bowlby (1969) described the fundamentally emotional aspect of the attachment relationship, and observed that the mother-infant relationship is "accompanied by the strongest of feelings and emotions, happy or the reverse," that this interaction occurs within a context of "facial expression, posture, tone of voice, physiological changes, tempo of movement, and incipient action," that attachment behavior is "vital to the survival of the species", and that the infant's "capacity to cope with stress" is correlated with certain maternal behaviors. He also speculated that attachment experiences are stored in the brain's emotion-processing limbic system. Recent studies support Bowlby's conceptions, and indicate that the development of the capacity to experience, communicate, and regulate emotions may be the key event of human infancy. In a continuation of Bowlby's interdisciplinary perspective, my own work focuses upon the neurobiology of attachment. I have suggested that the "experience" required for the "experience-dependent" maturation of the systems that regulate brain organization (and thereby personality) in the first two years of life is specifically the social-emotional experience embedded in the affect-regulating attachment relationship between the infant and the mother. In my book Affect Regulation and the Origin of the Self (1994) and continuing studies I offer evidence to show that early interpersonal affective experiences directly influence the experience-dependent maturation of the early developing regulatory systems of the right brain. The relationship with the primary attachment object has a critical effect on, as Bowlby speculated, the organization of the limbic system, the central nervous system brain areas specialized not only for the processing of emotion but for the organization of new learning and the capacity to adapt to a rapidly changing environment. The limbic system is expanded in the nonverbal right hemisphere, which is dominant for the processing of the physiological and cognitive components of emotions. The right hemisphere, which is centrally involved in emotional communications, is in a growth spurt in the first year and a half. It, more so than the later developing verbal left hemisphere, is deeply connected into the prenatally and postnatally maturing autonomie nervous system that is responsible for the somatic components of emotion, and into the hypothalamo-pituitary-adrenal axis. This hemisphere is thus dominant for the mobilization of the vital functions that enable the organism to cope actively and passively with stress, and therefore for the control of vital functions supporting survival and for the human stress response (Wittling, 1997). The continuity of an individual's coping responses is a major component of the personality. The nonverbal right brain, the emotional brain, or as the neuroscientist Robert Ornstein (1997) calls it "the right mind" is dominant in

human infants, and indeed, for the first 3 years of life (Chiron et al., 1997). This right brain growth advantage is also seen prenatally (Chi, Dooling &Gilles, 1977). On the matter of continuity between prenatal and postnatal periods Thomas Verny (2002) is now writing that, Every experience on the road of prenatal life alters the molecules of emotion, the autonomie and nervous central nervous systems, and the architecture of the brain.. .The three years of life following birth will, to a very large extent, determine how much and in which direction the child's potential and nascent personality traits develop . . . Before birth, experiences help to lay down the brain's primary circuits forming a foundation for development; after birth, the networking activity moves to increasingly higher levels of the cerebral cortex, fine-tuning sensory perception, emotional balance, cognitive skills, and interpersonal relationships. In this presentation I will very briefly sketch out what we now know about the emotion transacting attachment experiences that occur after birth and how these indelibly shape the right brain and thereby the genesis of personality. ATTACHMENT PROCESSES AS DYADIC EMOTIONAL COMMUNICATIONS The third trimester of pregnancy, the onset of the infant's brain growth spurt, is also the time when women form relatively stable representations of self and baby. Researchers have established that the quality of the mother's representation of her unborn child are linked to her own early attachment relationship, that this representation, acting at nonconscious levels, has a profound impact on ensuing postnatal attachment transactions, and that maternal prenatal attachment is associated with postnatal maternal involvement in the infantmother interaction (Cohen &Slade, 2000; Siddiqui &Hagglof, 2000; Schore, 2001). From birth onwards, the infant is using its expanding coping capacities to interact with the social environment. In the earliest protoattachment experiences, the infant is utilizing its maturing motor and developing sensory capacities, especially smell, taste, and touch. But by the end of the second month there is a dramatic progression of its social and emotional capacities. Functional magnetic resonance imaging studies now demonstrate a milestone for normal development of the infant brain occurs at about 8 weeks (Yamada et al., 2000). At this point a rapid metabolic change occurs in the primary visual cortex of infants. This rise is interpreted to reflect the onset of a critical period in which synaptic connections in the occipital cortex are modified by visual experience. In particular, the mother's emotionally expressive face is, by far, the most potent visual stimulus in the infant's environment, and the child's intense interest in her face, especially in her eyes, leads him to track it in space, and to engage in periods of intense mutual gaze. The infant's gaze, in turn, reliably evokes the mother's gaze, thereby acting as a potent interpersonal channel for the transmission of "reciprocal mutual influences." It has been observed that the pupil of the eye acts as a nonverbal communication device and that large pupils in the infant release caregiver behavior. It has been said that "learning how to communicate represents perhaps the most important developmental process to take place during infancy" (Papousek &Papousek, 1997, p. 42). What do we know about this process? As described by Feldman and her colleagues, "face-toface interactions, emerging at approximately 2 months of age, are highly arousing, affect-laden, short interpersonal events that expose infants to high levels of cognitive and social information. To regulate the high positive arousal, mothers and infants . . . synchronize the intensity of their affective behavior within lags of split seconds" (Feldman, Greenbaum, &Yirmiya, 1999, p. 223). These episodes of "affect synchrony" occur in the first expression of social play, and they are patterned by an infant-leads-mother-follows sequence. In this interactive context both synchronously match states and then simultaneously adjust their social attention, stimulation, and accelerating arousal to each other's responses. Within episodes of affect synchrony parents engage in intuitive, nonconscious, facial, vocal, and gestural preverbal communications. These experiences, which the parent carries out "unknowingly and can hardly control consciously" "provide young infants with a large amount of episodes-often around 20 per minute during parent-infant interactions-in which parents make themselves contingent, easily predictable, and manipulatable by the infant" (Papousek et al., 1991, p. 110). In order to regulate the high positive arousal, mothers and infants synchronize the intensity of their affective behavior within lags of split seconds. This moment-to-moment state sharing represents an organized dialog occurring within milliseconds, and it acts as an interactive matrix in

which both partners match states and then simultaneously adjust their social attention, stimulation, and accelerating arousal in response to the partner's signals. According to Lester, Hoffman, and Brazelton "synchrony develops as a consequence of each partner's learning the rhythmic structure of the other and modifying his or her behavior to fit that structure" (1985, p. 24). This microregulation continues, as soon after the "heightened affective moment" of an intensely joyful full gaze smile the baby will gaze avert in order to regulate the potentially disorganizing effect of this intensifying emotion. In order to maintain the positive emotion the attuned mother takes her cue and backs off to reduce her stimulation. She then waits for the baby's signals for reengagement. In this way, not only the tempo of their engagement but also their disengagement and reengagement is coordinated. In this mutually regulated process the more the mother tunes her activity level to the infant during periods of social engagement, the more she allows him to recover quietly in periods of disengagement, and the more she attends to the child's reinitiating cues for reengagement, the more synchronized their interaction. In this early system of nonverbal emotional communication the infant and mother co-create a context which allows for the outward expression of internal affective states in infants. In order to enter into this communication, the crescendos and decrescendos of the mother's affective state must be in resonance with similar crescendos and decrescendos of the infant's internal states of arousal. She also must monitor her own internal signals and differentiate her own affective state, as well as modulating nonoptimal high levels of stimulation which would induce supra-heightened levels of arousal in the infant. The burgeoning capacity of the infant to experience increasing levels of accelerating, positive affects (joy and excitement) is thus at this stage amplified and externally regulated by the psychobiologically attuned mother, and depends upon her capacity to engage in an interactive emotion communicating mechanism that generates these in herself and her child. But the primary caregiver is not always attuned-developmental research shows frequent moments of misattunement in the dyad, ruptures of the attachment bond. Although short-term dysregulations are not problematic, prolonged negative states are toxic for infants, and although they possess some capacity to modulate low intensity negative affect states, these states continue to escalate in intensity, frequency, and duration. In early development an adult provides much of the necessary modulation of infant states, especially after a state disruption and across a transition between states, and this allows for the development of self regulation. Studies of interactive attunement following dyadic misattunement, of "interactive repair", support Winnicott's (1975) conception of the mother's "holding" or "containing" function as the capacity to "stay with" the child through its emotional/impulsive expressions, "to hold the situation in time". In this pattern of "disruption and repair", the "good enough" caregiver who induces a stress response in her infant through a misattunement, reinvokes in a timely fashion a reattunment, a regulation of the infant's negative state. If attachment is interactive synchrony, stress is defined as an asynchrony in an interactional sequence, and, following this, a period of re-established synchrony allows for stress recovery. The mother and infant thus dyadically negotiate a stressful state transition. Infant resilience emerges from the child and parent transitioning from positive to negative and back to positive affect. In this manner, the child learns how to tolerate, regulate, and cope with negative affective states. These arousal-regulating transactions, which continue throughout the first and second year, underlie the formation of an attachment bond between the infant and primary caregiver. To put this another way, in forming an attachment bond of regulated emotional communications, the mother is synchronizing and resonating with the rhythms of the infant's dynamic internal states and then regulating the arousal level of these negative and positive states. Attachment is thus the dyadic (interactive) regulation of emotion. The baby becomes attached to the psychobiologically attuned regulating primary caregiver who not only minimizes negative affect but also maximizes opportunities for positive affect. The regulatory processes of affect synchrony that creates states of positive arousal, and interactive repair that modulates states of negative arousal, are the fundamental building blocks of attachment and its associated emotions. These data underscore an essential principle overlooked by many emotion theorists-affect regulation is not just the dampening of negative emotion. It also involves an amplification, an intensification of positive emotion, a condition necessary

for more complex self-organization. Attachment is more than 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. Regulated affective interactions with a familiar, predictable primary caregiver create not only a sense of safety, but also a positively charged curiosity that fuels the burgeoning selfs exploration of novel socioemotional and physical environments. It is important to note that these affect regulating transactions are generating important events in the infant's bodily state, that is, at the psychobiological level. Winnicott proposes, "The main thing is a communication between the baby and mother in terms of the anatomy and physiology of live bodies" (1986, p. 258). Developmental psychobiological research is revealing that in the "symbiotic" state the adult's and infant's individual homeostatic systems are linked together in a superordinate organization which allows for mutual regulation of vital endocrine, autonomie, and central nervous systems of both mother and infant by elements of their interaction with each other. Psychobiologists are describing "hidden" regulatory processes by which the caregiver's more mature and differentiated nervous system regulates the infant's "open," immature, homeostatic systems. Thus, "emotion is initially regulated by others, but over the course of early development it becomes increasingly self-regulated as a result of neurophysiological development" (Thompson, 1990, p. 371). THE DEVELOPMENTAL NEUROBIOLOGY OF ATTACHMENT BOND FORMATION In other words, in addition to psychobiological consequences, attachment transactions also have neurobiological effects, they are "built into the nervous system, in the course and as a result of the infant's experience of his transactions with the mother." But how? Current models describe how these same nonverbal communications that induce instant emotional effects also facilitate brain growth. And so it is now thought that "the intrinsic regulators of human brain growth in a child are specifically adapted to be coupled, by emotional communication, to the regulators of adult brains" (Trevarthen, 1990, p. 357). In these transactions, the resonance of the dyad ultimately permits the intercoordination of positive affective brain states. The baby's brain, which is more than doubling its size in the first year, is not only affected by these transactions, it's growth literally requires brain-brain interaction in the context of an intimate positive affective relationship. This interactive mechanism requires older brains to engage with mental states of awareness, emotion, and interest in younger brains, and involves a coordination between the motivations of the infant and the subjective feelings of adults. This bond is forged through "spontaneous emotional communications," described as, "a conversation between limbic systems...It is a biologically-based communication system that involves individual organisms directly with one another: the individuals in spontaneous communication constitute literally a biological unit. The direct involvement with the other intrinsic to spontaneous communication represents an attachment that may satisfy deeply emotional social motives" (Buck, 1994, p. 266, my italics). These moments of imprinting, the very rapid form of learning that irreversibly stamps early experience upon the developing nervous system and mediates attachment bond formation, are described in the current neuroscience literature: When the child is held and hugged, brain networks are activated and strengthened and firing spreads to associated networks; when the child is sung to, still other networks are strengthened to receive sounds and interpret them as song. The repeated appearance of the mother provides a fixation object ... as in imprinting (Epstein, 2001, p. 45). Even more specifically, it is now thought that: The emotional experience of the infant develops through the sounds, images, and pictures that constitute much of an infant's early learning experience, and are disproportionately stored or processed in the right hemisphere during the formative stages of brain ontogeny (Semrud-Clikeman &Hynd, 1990, p. 198). And so in these affectively synchronized, psychobiologically attuned face-to-face interactions the infant's right hemisphere, which is dominant for the infant's recognition of the maternal face, for visual emotional information, and for the emotional tone of the mother's voice, is focusing her attention on and is therefore regulated by the output of the mother's right hemisphere, which is dominant for nonverbal communication, for the processing and expression of facially and vocally expressed emotional information, and for the maternal capacity to comfort the infant. The mother is downloading emotion programs into the infant's right brain. The child is using the output of the mother's right hemisphere as a template for the

imprinting, the hard wiring of circuits in his own right hemisphere that will come to mediate his expanding affective capacities, an essential element of his emerging personality. Thus, as Bowlby speculated, the mother shapes the baby's developing coping capacities by imprinting his developing limbic system. These body-to-body communications also involve right brain-to-right brain interactions. Indeed, human females cradle their infants on the left side of the body (controlled by the right hemisphere). This tendency is well developed in women but not in men, is independent of handedness, and is widespread in all cultures. It has been suggested that this left-cradling tendency "facilitates the flow of affective information from the infant via the left ear and eye to the center for emotional decoding, that is, the right hemisphere of the mother" (Manning et al., 1997, p. 327). Attachment is thus much more than a matter of match between cognitions. A focus on affect, by definition, returns us to the psychobiological roots of Bowlby's theory. Attachment, a right brain-to-right brain mechanism, is thus the regulation of biological synchronicity between and within organisms. What are the unique functions of the right brain? Current findings in neuroscience suggest that "while the left hemisphere mediates most linguistic behaviors, the right hemisphere is important for broader aspects of communication" (Van Lancker &Cummings, 1999, p. 95). A large number of studies indicate that this hemisphere is dominant for the nonconscious reception, expression, and communication of emotion. Indeed, evidence now suggest that the right brain is dominant for a sense of the emotional and corporeal self (Devinsky, 2000). But in addition, the representation of visceral and somatic states and body sense is under primary control of the "non-dominant" hemisphere. It is now thought that the right brain is centrally involved in "the analysis of direct information received by the subject from his own body and which ... is much more closely connected with direct sensation than with verbally logical codes" (Luria, 1973, p. 165). Indeed studies now show that self related material is processed in the right hemisphere (Keenan et al., 2001). Furthermore, activity of the right hemisphere is instrumental to the perception of the emotional states of other selves, that is, for empathy. The adaptive capacity to empathize with another's state is thus acquired in infant-mother right-lateralized conversations between limbic systems. A very recent neuroimaging study reports that "recognizing emotions from visually presented facial expressions requires right somatosensory cortices", and in this manner "we recognize another individual's emotional state by internally generating somatosensory representations that stimulate how the individual would feel when displaying a certain facial expression" (Adolphs et al., 2000, p. 2683). Empathy is, of course, a moral emotion, and a number of authors have stressed the importance of right hemispheric emotional-imagistic processes in moral development. Attachment experiences thus directly impact the neurobiological substrate of moral development. This highest level of the right brain, the orbitofrontal cortex, acts as a "Senior Executive" of the social-emotional brain. BOwlbV1S control system that regulates attachment and coping functions is located in the right orbitofrontal area and its cortical and subcortical connections, and it matures in the second year of life (although it retains plasticity at later periods). Indeed this prefrontal system acts at "the highest level of control of behavior, especially in relation to emotion," and plays a unique role in the adjustment or correction of emotional responses. It functions as a recovery mechanism that monitors and regulates the duration, frequency, and intensity of not only positive but negative affect states. These adaptive capacities are central to self-regulation, the ability to flexibly regulate emotional states through interactions with other humans-interactive regulation in interconnected contexts, and without other humans-autoregulation in autonomous contexts. In the current neuroscience literature, it is now thought that "the orbitofrontal cortex is involved in critical human functions, such as social adjustment and the control of mood, drive and responsibility, traits that are crucial in defining the 'personality' of an individual" (Cavada &Schultz, 2000, p. 205). Recent neurobiological research is now revealing the unique operations of the "non-dominant" right hemisphere: the storage of internal working models of the attachment relationship that are used as guides for future action, the processing of social-emotional information that is meaningful to the individual, the processing of information from within the body, the ability to empathize with the emotional states of other humans beings, the mediation of the processes that underlie moral development, the appreciation of humor, a mechanism for coping with daily stress, the

cerebral representation of one's own past and the activation of autobiographical memory, the establishment of a "personally relevant universe," and "the capacity to mentally represent and become aware of subjective experiences in the past, present, and future." The emergence of these adaptive right brain functions in the attachment relationship clearly represent critical aspects of the genesis of personality. OVERVIEW A summary overview of the current rapid advances in developmental psychology and brain research offers the following perspective of the early development of the self. It is now clear that psychological and physical health are inextricably intertwined, and that emotional development is the integrating link between mind and body. This interweaving of the mental and the biological realms is present at the very beginnings of human life. But the current explosion of infant research indicates that the human self-an individual's defining personality or character, his or her essential psychobiological nature-is not fully present at birth. The course of a healthy childhood is reflected in the expanding adaptive psychological and biological functions of a developing self. These capacities are, in turn, a product of a child's maturing brain/mind/body systems, and they optimally evolve only in a growth-facilitating environment. This environment provides not only adequate amounts of essential nutrients but, in addition, a range of essential social emotional experiences that also fuel the brain growth spurt of the first two years of life. In light of the dual principles that the earliest stages of self are critical to the further growth of the personality, and that nature's potential can be realized only as it is enabled by nurture, the optimal development of the earliest manifestation of self-potential involves more than just a genetically programmed inborn tendency to organize experiences. It also requires certain types of specifically social emotional experiences that are co-created in a relationship with a caregiver who is attuned to the infant's internal states and is responsive to the child's communications of such states. These psychobiological transactions begin prenatally, and then evolve in the infant-primary caregiver attachment relationship. This interactive context is thus the crucible, the nurturing matrix out of which the child's self is cultivated. All later continuing development rests upon this psychobiological base. In terms of attachment theory, in the first year, the primary caregiver is providing the infant certain regulated emotional experiences that allow for a secure bond between the two of them to form, a twoway channel of emotional communication to be created. As a result of this essential developmental accomplishment, the child can begin to acquire essential knowledge about his or her own and as well as the mother's internal states, and about how he or she can regulate these states by being with other human beings or within him or herself. In other words, in an optimal scenario the infant is an active coparticipant in a relationship with an emotionally attuned primary caregiver who provides self-maintaining experiences, that is, one who expands opportunities for positive emotion and minimizes states of negative emotion. These experiences occur in affect attunement interactions embedded in infant-mother play interactions, as well as in comforting reattunement transactions that occur after instances of stressful misattunement. Experiencing the joy of being the gleam in the parent's eye, and of having the secure feeling that one is under the watchful eye of the mother, even when she's not physically present, supports and nurtures the infant's burgeoning positive self esteem. Over the course of the first year these same attachment experiences directly influence the growth of the infant's brain, especially the higher areas of the right brain that are involved in reading the emotional faces, voices, and gestures of other humans, in appraising bodily responses to such social stimuli, in regulating resultant emotional states, and in coping with internal and external stress. By the end of the second year, the cumulative attachment history with both parents allows for a more complex right brain. This maturational advance now mediates an internal sense of security and resilience that comes from the intuitive knowledge that one can regulate the flows and shifts of one's emotional states either by one's own coping capacities or within a relationship with caring others. The outcome of a secure attachment is thus a reflection of the optimal development of the higher levels of the right brain, the locus of self functions. This developmental advance in right brain complexity is responsible for empathy, and therefore for that which makes an individual most "human". With an intact, relatively efficient right brain, or "right mind," a securely attached child is now capable of appreciating that certain internal subjective states are shareable with

others, that one is a human among other humans. This capacity for empathy gives him or her a sense of connectedness with others and therefore a human identity. To be a biological human and to be a psychological human are two very different things. To have the body of a human being is one thing, but to be able to feel that one's needs are of value to self and others, to have a secure personality, only emerges as a result of having the experience, at the very beginning of life, of being part of an ongoing relationship, both prenatally and postnatally, with an emotionally attuned adult human, a "good-enough" mother. References REFERENCES Adolphs, R., Damasio, H., Tranel, D., Cooper, G., &Damasio, A. R. (2000). A role for somatosensory cortices in the visual recognition of emotion as revealed by three-dimensional lesion mapping. Journal of Neuroscience, 20, 2683-2690. Bowlby, J. (1969). Attachment and loss. Vol. 1: Attachment. New York: Basic Books. Buck, R. (1994). The neuropsychology of communication: spontaneous and symbolic aspects. Journal of Pragmatics, 22, 265-278. Cavada, C., &Schultz, W. (2000). The mysterious orbitofrontal cortex. Foreword. Cerebral Cortex, 10, 205. Chi, J. G., Dooling, E.C., &Gilles, F. H. (1977). Gyral development of the human brain. Annals of Neurology, 1, 86-93. Chiron, C., Jambaque, I., Nabbout, R., Lounes, R., Syrota, A., &Dulac, O. (1997). The right brain hemisphere is dominant in human infants. Brain, 120, 1057-1065. Cicchetti, D. &Tucker, D. (1994). Development and self-regulatory structures of the mind. Development and Psychopathology, 6, 533-549. Cohen, L. J., &Slade, A. (2000). The psychology and the psychopathology of pregnancy: reorganization and transformation. In C. H. Zeanah (Ed.), Handbook of infant mental health, 2nd Ed. (pp. 20-36). New York: Guilford Press. Connely, K. J., &Prechtl, H. F. R. (1981). Maturation and development: Biological and psychological perspectives. Philadelphia: Lippincott. Devinsky, O. (2000). Right cerebral hemisphere dominance for a sense of corporeal and emotional self. Epilepsy &Behavior, 1, 60-73. Dowling, A. L. S., Martz, G. U., Leonard, J. L., &Zoeller, R.T. (2000). Acute changes in maternal thyroid hormone induce rapid and transient changes in gene expression in fetal rat brain. Journal of Neuroscience, 20, 2255-2265. Epstein H. T. (2001). An outline of the role of brain in human cognitive development. Brain and Cognition, 45, 44-51. Feldman, R., Greenbaum, C. W., &Yirmiya, N. (1999). Mother-infant affect synchrony as an antecedent of the emergence of self-control. Developmental Psychology, 35, 223-231. Keenan, J. P., Nelson, A., O'Connor, M., &Pascual-Leone, A. (2001). Self-recognition and the right hemisphere. Nature, 409, 305. Lester, B. M., Hoffman, J., &Brazelton, T. B. (1985). The rhythmic structure of motherinfant interaction in term and preterm infants. Child Development, 56, 15-27. Luria, A. R. (1973). The working brain. New York: Basic Books. Manning, J. T., Trivers, R. L., Thornhill, R., Singh, D., Denman, J., Eklo, M. H., &Anderton, R. H. (1997). Ear asymmetry and left-side cradling. Evolution and Human Behavior, 18, 327-340. Ornstein, R. (1997). The right mind: Making sense of the hemispheres. New York: Harcourt Brace. Papousek, H., Papousek, M., Suomi, S. J., &Rahn, C. W. (1991). Preverbal communication and attachment: Comparative views. In J. L. Gewirtz &W. M. Kurtines (Eds.), Intersections with attachment (pp. 97-122). Hillsdale, NJ: Erlbaum. Papousek, H., &Papousek, M. (1997). Fragile aspects of early social integration. In L. Murray &P. J. Cooper (Eds.), Postpartum depression and child development (pp. 35-53). New York: Guilford Press. Schore, A. N. (1994). Affect regulation and the origin of the self: The neurobiology of emotional development. Mahwah, NJ: Erlbaum. Schore, A. N. (2001). Effects of a secure attachment relationship on right brain development, affect regulation, and infant mental health. Infant Mental Health Journal, 22, 7-66. Semrud-Clikeman, M., &Hynd, G. W. (1990). Right hemisphere dysfunction in nonverbal learning disabilities: Social, academic, and adaptive functioning in adults and children. Psychological Bulletin, 107, 196-209. Siddiqui, A., &Hagglof, B. (2000). Does maternal prenatal attachment predict postnatal mother-infant interaction? Early Human Development, 59, 13-25. Thompson, R. A. (1990). Emotion and self-regulation. In Nebraska symposium on motivation (pp. 367-467). Lincoln: University of Nebraska Press. Trevarthen, C. (1990). Growth and education of the hemispheres. In C. Trevarthen (Ed.), Brain circuits and functions of the mind (pp. 334-363). Cambridge, England: Cambridge University Press. Van Lancker, D., &Cummings, J. L. (1999). Expletives: Neurolinguistic and neurobehavioral perspectives on swearing. Brain Research Reviews, 31, 83-104. Verny, T. R. (2002). Tomorrow's baby. New York: Simon

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