

(excerpts of notes only)

Traumatic Attachment and the Development of the Right Brain

A Plenary Address by Allan N. Schore, Ph.D. at the EMDRIA Conference, 9/9/2000

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As Bessel van der Kolk mentioned yesterday during his talk, we are finding that a number of people experience multiple traumas and stressors over their lifetime - and that their capacity to cope often breaks down during those times. I want to address this particular population, and ask you to keep in mind what the early history of your severely traumatized patients looks like. We talk about physical and emotional abuse, but I want to suggest that the origins of susceptibility to Post Traumatic Stress Disorder (PTSD) are much earlier than we have previously thought.

A recent national study published in The Archives of General Psychiatry reported that 60% of men and 50% of women in the U.S. experience a traumatic event at some point in their lives. And yet, this same study found that estimates of lifetime PTSD are 5% for men and 10% for women. This finding underscores a central issue. Although trauma is a common element in many, if not most lives, why do only a certain minor proportion of individuals exposed to various forms of trauma develop pathological reactions?

A major change in our approach to this problem is reflected in the shift from the DSM-III-R, where the severity of the trauma was considered the key factor in precipitating PTSD, to the DSM-IV, where characteristics of the victim (including their reaction to the trauma) are emphasized. In other words, the etiology of PTSD is best understood in terms of what an individual brings to a traumatic event, and not just characteristics of the event itself. This clearly implies that certain personality patterns are specifically associated with the unique ways in which individuals cope, or fail to cope with stress.

This "modern" concept was actually first proposed in 1889 by *Pierre Janet. Janet proposed that when certain individuals experience what he called "vehement emotions" their minds are unable to match the frightening experiences with existing cognitive schemas, and so the memories of these experiences are split off, dissociated from consciousness and voluntary control. Thus, the first comprehensive formulation of the effects of trauma was based on the notion that extreme emotional arousal results in a failure to integrate traumatic memories.

Janet held that the psychological consequence of trauma is "the breakdown of the adaptive mental processes leading to the maintenance of an integrated sense of self" - a rather modern notion for 1889. He further postulated "All traumatized patients seem to have the evolution of their lives checked." Unable to integrate traumatic memories, they seem to lose their capacity to assimilate new experiences as well. It is as if their personality development has stopped at a certain point, and cannot enlarge any more by the addition of new elements.

As you know, the issue of trauma has been quite controversial. Freud rejected the concept of dissociation in favor of repression as the major mechanism of psychopathology. It's only within the last ten years that the field of mental health has begun to again delve more into the unique

psychopathological manifestations of trauma and dissociation. Bessel van der Kolk and Francine Shapiro have been pioneers in this effort. This renewed clinical interest is stimulated by recent attempts to expand psychotherapeutic treatment models to patients with severe developmental disorders, and I would suggest that EMDR practitioners have been at the forefront of this trend.

At this same time, a number of other disciplines are investigating trauma. Current psychiatric studies now reveal that the breakdown of adaptive mental processes in patients with PTSD represents a characterological failure to cope with stress. Basic research in stress physiology now shows that the behavioral and physiological response of an individual to a specific stressor is consistent over time.

*Janet, Pierre Marie Felix, 1859-1947, French psychologist.

Developmental studies of childhood trauma are offering more complex models of how a developing individual becomes attached to an unsurmountable object. Currently, there is an intense interest in the relationship between early traumatic attachments and a later vulnerability to PTSD. Neuroscience is now revealing how early abuse and neglect negatively impact the growth of the brain's regulatory systems involved in coping with stress - and therefore have far reaching effects.

In light of the documented psychophysiological principle that social stressors are far more detrimental than non-social aversive stimuli, the most deleterious trauma that can occur in childhood comes from the social-interpersonal environment - and not from the physical environment. Because such trauma is typically ambient, the stress embedded in on-going relational trauma is therefore not a single event - but cumulative little "t" traumas. Research documents the fact that the most serious maltreatment occurs to infants under two years of age, and that homicide is the leading cause of death for children under age four. (This comes from a study in Britain showing causes of death from infancy to the first year.)

In 1997, there was an important study published in *The Journal of Pediatrics* in which covert video recordings of infants hospitalized due to life-threatening events were used. This study documents in a careful and disturbing manner the various forms of child abuse inflicted by caregivers on infants as young as three months, while they were in the hospital. Such experiences are also recorded and stored in the infant's brain. One researcher (*Perry?) has written that literal mirroring of traumatic events by behavioral memory can be established at any age, including infancy.

Although Freud struggled with the concept of trauma over the course of his career, in his very last work, he asserted that trauma in early life is especially psychopathogenic - and that it affects all vulnerable humans because "the ego is feeble, immature and incapable of resistance." Today we know this is so, because trauma negatively impacts the infant's developing brain.

An entire recent issue of *The Journal of Biological Psychiatry* is devoted to brain development and vulnerability, and contains two studies on developmental traumatology where the authors conclude that, "the overwhelming stress of maltreatment in childhood is associated with adverse influences on brain development." Prolonged and frequent episodes of intense and unregulated interactive stress in infants have devastating effects on not only the development of stable and trusting attachment relationships, but also on the establishment of psychophysiological regulation. The enduring effects of abuse are now thought to be "deviations in the development of patterns of social information processing."

In this presentation, I want to suggest that early, severe relational trauma alters the development of the right hemisphere of the brain, the hemisphere that is dominant in the unconscious processing of social and emotional information. The right hemisphere is also dominant in the regulation of body states and attachment functions. The early maturing right hemisphere is in a growth spurt in the first two years of life, and is dominant in the first three years of life. It's not

until the fourth year that the left hemisphere of the brain becomes dominant in human development.

The Right Hemisphere and the Human Stress Response: To return to Janet, a trauma induced developmental failure of the experience-dependent maturation of the regulatory systems in the right hemisphere underlies the inability to assimilate new emotional experiences that are required for further personality development. More specifically, it's not just the attachment trauma, but the primitive use of certain defensive structures that block the developmental process. For the rest of the life span, the right hemisphere (and not the later maturing left) stores autobiographical memories. An enduring developmental impairment of this system is expressed as a severe limitation to control vital functions supporting survival, and enabling the organism to cope actively and passively with emotional stress.

- This structural limitation of the right hemisphere of the brain, the hemisphere dominant for the human stress response, is responsible for the individual's characterological inability to regulate affect which I, (Bessel van der Kolk and others) now believe is at the core of trauma psychopathology.

*Please note that the names of the researchers Dr. Schore refers to throughout this presentation have been spelled phonetically, and therefore may be incorrect . (He did not include a bibliography in his handout.)

A Review of the Neurobiology of a Secure Attachment: A cardinal principle of the field of developmental psychopathology is that both normal and abnormal development must be understood in terms of common underlying mechanisms. Therefore, I will briefly review the neurobiology of a secure attachment, and then outline the effects of traumatic experiences on the early developing right hemisphere of the brain focusing on a regulatory system in the prefrontal areas of the right hemisphere.

This frontal system is not only involved in central nervous system (CNS) comprehension of emotional functions, but it is also deeply connected to the autonomic nervous system (ANS). Although many clinicians have noted the dysfunction of memory and cognition in severe developmental disorders and traumatic states, I want to suggest that it's a dysregulation of CNS arousal and ANS bodily states of both mind and body that is at the core of the most severe forms of self pathology. Later I will cover a couple of implications for treatment of this dysregulation.

The essential task of the first year of human life is the creation of a secure attachment bond between the infant and the psychobiologically attuned primary caregiver. This slide shows that the interaction of the attachment relationship is definitely a biological one between two bodies. This attachment interaction also affects the maturation of the brain. The emotional communications embedded in the secure attachment experience directly influence the maturation of the emotion-processing limbic system. This slide shows the orbitofrontal cortex at the hierarchical apex of the limbic system. The cingulate is next and then the amygdala. These are the three major structures within the limbic system. The hypothalamus and brain stem reticular formation come next (see the chart on page 12 of these notes).

In attachment interactions, the mother acts as an interactive regulator of the infant's arousal levels as well as the infant's positive and negative states. The limbic system, which is more deeply connected to the early developing right hemisphere, functions to organize new learning and to allow the brain to adapt to a rapidly changing environment. Both the CNS limbic system and the sympathetic and parasympathetic components of the ANS (including their common interconnections) are maturing in infancy - and are directly influenced by the infant-mother relationship. She literally shapes the circuits of the infant's brain.

A hierarchy of limbic circuits evolves over the first year: the amygdala at birth, the anterior cingulate at two-three months, and the orbitofrontal cortex by the end of the first year. A simple definition of attachment is the dyadic regulation of emotion which acts as an interpersonal matrix for organizing circuits in the prefrontal areas of the infant's right hemisphere - the areas that are involved in self-regulatory functions. Due to its position at the interface of the cortex and the sub-cortex, the orbitofrontal cortex is literally at the hierarchical apex of the limbic system - which includes the amygdala at a lower level. It also directly connects to the sub-cortical reticular formation, thereby regulating limbic arousal.

In addition, by way of its direct connections to the hypothalamus (the head ganglion of the ANS), it acts as a cortical control center of involuntary functions that represent the somatic components of all emotional states, i.e., heart rate, blood pressure, skin conductors, etc.

The sympathetic nervous system on the left is energy expending. It produces increases in heart rate and generates states of high autonomic arousal. The parasympathetic nervous system is energy conserving. It produces decreases in heart rate and low arousal states - thereby creating balance.

The orbitofrontal cortex is located right above the orbit of the eye, and it is expanded in the early developing right hemisphere of the brain. Because it is more deeply connected to the ANS, it regulates bodily-based emotional states. Both the hypothalamic/pituitary/adrenal cortical axis and the sympathetic/adrenal/ medullary axis underlie the stress response, and are under the main control of the right cerebral cortex. Thus, the right hemisphere of the brain contains a unique response system to prepare the organism to deal efficiently with external challenges - to adapt and mediate the human stress response.

Attachment Theory John Bowlby, the father of Attachment Theory, suggested that the mother shapes the infant's coping systems. Following his lead, my work indicates that Bowlby's control system (that regulates attachment and coping functions) is located in the right orbitofrontal area, and its cortical and sub-cortical connections. This prefrontal system acts at the highest level of control of behavior, especially in relation to emotion.

In an optimal early environment that promotes a secure attachment, a right lateralized regulatory system organizes the capacity for the individual to engender (under stress) a flexible coping mechanism of "coupled reciprocal autonomic control" in which increases in the activity of the sympathetic nervous system are affected by decreases in the parasympathetic nervous system, and vice versa - so that one system balances the other.

As previously stated, the orbitofrontal area is situated at the hierarchical apex of what is known as the rostral (sp?) limbic system, which includes the cingulate and the amygdala. The early maturing amygdala acts as a sensory gateway to the limbic system, and although rapid, amygdala processing is crude compared with the more complex processing of affective stimuli by the later maturing cortical limbic areas.

A recent fMRI study demonstrates that while the sub-cortical amygdala (in the lower level of the limbic system) responds to emotional stimuli at a direct perceptual level - its operations are less relevant to cognitively elicited emotions.

In contrast, the orbitofrontal cortex (at the highest level of the limbic system) is activated in contexts of uncertainty - where there is insufficient information available to determine the appropriate course of action. So this orbitofrontal system (which is the outcome of a secure attachment) acts implicitly and non-consciously (by non-conscious biases), and is centrally involved in all forms of emotion-related learning and cognitive-emotional interactions. Therefore, it is known as the "thinking" part of the emotional brain (and is off-line in trauma).

In optimal developmental environments, (as the brain becomes more complex) the orbitofrontal cortex takes over amygdala functions for the infant, and provides a higher level of coding that

more flexibly coordinates interoceptive and exteroceptive domains - and functions to correct responses as conditions change. So the orbitofrontal region (which is the senior executive of the social/emotional brain) comes to act in the capacity of an executive regulator - an executive control function for the entire right hemisphere of the brain.

- This hemisphere (dominant for unconscious processes) stores an internal working model of the attachment relationship that determines the individual's characteristic approach to affect regulation. In the securely attached individual, this model encodes an implicit expectation that homeostatic disruptions will be set right - allowing the child ultimately to self-regulate functions which previously required the caregivers external regulation. The right lateralized system thus plays a unique role in the adjustment or correction of emotional responses. It acts as a recovering mechanism that monitors and regulates the duration, frequency and intensity of not only negative but positive states. Its capacities are central to self-regulation - either the ability to regulate self-states without other human beings (that is, auto-regulation), or through interaction with other human beings (that is, interactive regulation).

- Furthermore, the activity of the right hemisphere is instrumental in the empathic perception of the emotional states of other human beings. Empathy is not in the left hemisphere, it's in the right hemisphere.

- In the article, "The Mysterious Orbitofrontal Cortex" published in a recent issue of the journal Cerebral Cortex, the editors conclude that "the orbitofrontal is involved in critical human functions such as social adjustment and the control of mood, and drive and responsibility - traits that are crucial in defining the personality of an individual." This clearly implies that a developmentally impaired orbitofrontal system is associated with Janet's personality development that has stopped at a certain point.

- The Neurobiology and Psychobiology of Infant Trauma: It's important to stress the point that the developmental attainment of an efficient internal system that can adaptively regulate various forms of arousal and psychobiological states, and thereby affect cognition and behavior, is not purely genetically encoded. It only evolves in the context of a facilitating emotional environment. The "good-enough" mother of the securely attached infant permits access to the child after a separation, and shows a tendency to respond appropriately and promptly to his or her emotional expressions. She also allows for the interactive generation of high levels of positive affect in co-shared play states. These regulated events allow for an expansion of the child's coping capacities, and thus security of the attachment bond is the primary defense against trauma-induced psychopathology.

- In contrast, the abusive caregiver not only shows less play with her infant, she also induces traumatic states of enduring negative affect in her child. Because her attachment is weak, she provides little protection against other potential abusers of the infant, such as the father. The abusive caregiver is inaccessible and reacts to her infant's expression of emotions and stress inappropriately and/or rejectingly, and therefore shows minimal or unpredictable participation in the various types of arousal-regulating processes. Instead of modulating, the primary attachment figure here induces extreme levels of stimulation and arousal. And because she provides no interactive repair, the infant's intense negative states last for very long periods of time.

- We now know that trauma causes biochemical alterations within the developing brain. *Perry shows that the infant's psychobiological response to trauma is composed of two separate response patterns - always these two, and always in the same order. The first is hyperarousal, and the second is dissociation.

In the initial stage of a threat, an alarm reaction is initiated in which the sympathetic component of the ANS is suddenly and significantly activated - resulting in increased heart rate, increased blood pressure and respiration. Distress is expressed by crying and then screaming. This state of fear/terror is mediated by sympathetic hyperarousal, and reflects increased levels of the major

stress hormone of the brain (the corticotropin releasing factor) - which in turn regulates adrenaline and noradrenaline activity. In such kindling states, high levels of excitatory transmitters (such as glutamate, the major excitatory transmitter of the brain) are released in the limbic system.

- As previously stated, dissociation is a second later-forming reaction to infant trauma. In dissociation the infant disengages from stimuli in the external world and attends to an internal world. Dissociation in the midst of terror involves numbing, avoidance, compliance and restricted affect. Traumatized infants are observed staring off into space with a glazed look. This has been seen in infants as young as three months of age.

- This parasympathetic dominant state of what is called “conservation withdrawal” occurs in hopeless and helpless stressful situations at all stages of a lifespan in which the individual becomes inhibited and strives to avoid attention - in order to become unseen. This metabolic shutdown is a primary regulatory process used throughout the lifespan of a stressed individual. It involves passively disengaging in order to conserve energy to foster survival by the risky posture of “feigning death” to allow healing of wounds, and restitution of depleted resources. This parasympathetic mechanism mediates what Barach calls “the profound detachment of dissociation.”

If early trauma is experienced as psychic catastrophe, dissociation represents detachment from an unbearable situation - what Putnam calls “the escape when there is no escape.” Therefore, this is a “last resort” defensive strategy.

Most importantly, the neurobiology of the dissociative reaction is different from the initial hyperarousal response. In this passive state, pain numbing and blunting endogenous opiates, and behavior inhibiting stress hormones (such as cortisol) are elevated. In addition, the vegetative system in the dorsal nucleus of the vagus nerve in the medulla is activated, thereby decreasing blood pressure and lowering heart rate despite the increases in circulating adrenaline. This elevated parasympathetic arousal allows the infant to maintain homeostasis in the face of an internal state of sympathetic hyperarousal. So as the sympathetic goes up, the parasympathetic has to go up too in order to form somewhat of an equilibrium. Therefore, in the traumatic state (and this may be of long duration), both the sympathetic energy expending and the parasympathetic conserving components of the infant’s developing ANS are hyperactivated.

Thus the developing brain of an infant, who experiences frequent intense attachment disruptions, is chronically exposed to states of impaired homeostasis - which he or she shifts into in order to maintain basic metabolic processes for survival. If the caregiver does not participate in reparative functions that reduce stress and re-establish psychobiological equilibrium, the limbic connections that are in the process of developing are exposed to heightened levels of excito-toxic neurotransmitters (such as glutamate and cortisol) for long periods of time. The result is a toxic chemistry that negatively impacts the developing brain.

High levels of glutamate and cortisol are known to alter the growth of the developing limbic system and to destroy synapses. Early adverse developmental experiences may leave behind a permanent physiological reactivity in limbic areas of the brain, thereby inhibiting its capacity to cope with future stressors. Thus, infants who experience states of terror and dissociation and little interactive repair (especially those with a genetic predisposition and an inborn neurophysiological vulnerability) are at high risk for developing severe pathologies later on in life.

How is trauma-induced psychobiological and neurobiological alterations of the developing brain expressed in the behavior of an early traumatized infant? Keep in mind that early trauma is a common developmental experience of PTSD and borderline patients, and that early traumatic experiences, family history and the nature of parental relationships are known to be high risk factors of vulnerability for developing PTSD.

The Neuropsychology of an Insecure-Disorganized/Disoriented Attachment Pattern: In a classic study, Main and Solomon studied the attachment patterns of infants who had suffered trauma in the first year of life. This led to the discovery of a new attachment category in the late 1980s - Type D, the most pathological attachment. Type D is the insecure, disorganized, disoriented pattern found in 80% of maltreated infants. This group of infants exhibit the highest cortisol levels of all the other attachment classifications, (which this chart shows on the right). Also notice that in the attachment procedure known as "the strange situation" Type D infants have massive exhilaration of heart rate - much higher than either of the other two forms of insecure attachment.

Main contends that their disorganization and disorientation reflects the fact that instead of finding a haven of safety in the caregiving relationship the infant is alarmed by the parent. She notes, "Because the attached infant inevitably seeks the parent when alarmed, any parental behavior that directly alarms the infant places him or her in an unsolvable paradox - in which he or she can neither approach, shift attention, nor flee." Main documented in some detail the uniquely bizarre behaviors a group of twelve-month old infants showed in "the strange situation."

Main writes, "These episodes of interruption of organized behavior are often very brief, frequently lasting only 10 to 30 seconds - yet they are highly significant." For example, they showed a simultaneous display of contradictory behavior patterns such as backing toward the parent, rather than approaching face to face. "The impression in each case was that approach movements were continually being inhibited. In most cases, however, proximity seeking sufficiently overrode avoidance to permit an increase in physical proximity. Thus, contradictory patterns were activated, but were not mutually inhibited. Notice (in this chart) the simultaneous activation of the energy-expending sympathetic, and the energy-conserving parasympathetic components of the ANS.

Maltreated infants also show evidence of apprehension and confusion, as well as very rapid shifts of state during a distress-inducing "strange situation" (the attachment measure). Main describes, "One infant hunched her upper body and shoulders at hearing her mother's call, then broke into extravagant laugh-like screeches with an excited forward movement. Her braying laughter became a cry and a distressed face, without a new intake of breath - as the infant hunched forward. Then suddenly she became silent, blank and dazed."

These behaviors generalize beyond interactions with the mother. The intensity of the infant's dysregulated affective state is often heightened when the infant is exposed to the added stress of an unfamiliar person. At the stranger's entrance (in the "strange situation") two infants moved away from both mother and stranger to face the wall, and another "leaned her forehead against the wall for several seconds, while looking back in apparent terror."

These infants exhibit "behavioral stilling" - that is, dazed behavior and depressed affect (again a hyperactivation of the parasympathetic nervous system). One infant became for a moment excessively still, staring into space as though completely out of contact with self, environment, and parent. Another showed a dazed facial appearance accompanied by a stilling of all body movements - a freezing of limbs which had been in motion. Yet another fell face down on the floor in a depressed posture prior to separation, stilling all bodily movements.

Main points out that Type D behaviors will take the form of stereotypes that are frequently found in neurologically impaired infants. These behaviors are overt manifestations of an obviously impaired regulatory system, one that rapidly disorganizes under stress. Notice that these observations took place at 12 to 18 months, which is when the orbitofrontal cortex is formed, and reflect a severe structural impairment of this control system that is vitally involved in attachment behavior and state regulation.

The orbitofrontal cortex (like other areas in the limbic system such as the amygdala) contains neurons that fire to emotionally expressive faces.

- The mother's face is known to be the most potent visual stimulus in the infant's world. Her direct gaze, in addition to communicating loving messages, can also mediate powerful aggressive messages. During the trauma, I would suggest that the infant is presented with an aggressive facial expression on the caregiver's face. This image, as well as the chaotic alterations of the infant's body that are associated with it, are indelibly imprinted in the limbic circuits as a "flashbulb" memory. Therefore, it is stored in imagistic, implicit procedural memory in the visual/spacial right hemisphere of the brain. Such stored memories are what Lieberman calls "negative maternal attributions." They contain an intensely affective charge, and rapidly dysregulate the infant.

Main suggests that during the trauma, the infant may also be presented with another affectively overwhelming expression, a maternal expression of fear/terror - of terror on the mother's face. Main notes that this occurs when the mother withdraws from the infant, as though the infant were the source of alarm, and she reports that dissociated, trance-like and fearful behavior is often observed in the parents of Type D infants.

Other current studies also show a link between disorganized infant attachment and frightening maternal behavior. I suggest that during traumatic episodes, the infant matches the rhythmic structures of the mother's dysregulated states, and that this synchronization is registered in the firing patterns of the stress-sensitive cortico-limbic regions of the infant's brain that are in a critical period of growth at the time. Even more specifically, this could involve a mutual entrainment of their amygdala activities.

As Damasio points out, the role of the amygdala appears to be of special importance for social judgment of faces that are normally classified as "unapproachable and untrustworthy." This is consistent with the amygdala's demonstrated role in processing threatening and aversive stimuli. This description characterizes the infant's subjective perception of the visual and auditory stimuli emanating from an abusive caregiver's face.

- In a recent study, mothers of children with disorganized attachments describe themselves as being out of control, inflicting harsh punishments, feeling depressed, and unable to care for or protect their infants. In light of the fact that many of these mothers have suffered from unresolved trauma themselves, the spacial/temporal imprinting of the chaotic alterations of the mother's dysregulated state in the infant's brain may be a mechanism for the downloading of programs of psychopathology, a context for the inter-generational transmission of trauma.

More specifically, in certain critical moments, the caregiver's entrance into a dissociative state represents the real time manifestation of neglect. Such a context of an emotionally unavailable dissociating mother, and a disorganized infant is evocatively captured by Selma Freiberg in the following quote. "The mother had been grudgingly parented by relatives after her mother's post-partem attempted suicide, and had been sexually abused by her father and cousin. During a testing session, her baby began to cry a hoarse eery cry. On tape, we see the baby in the mother's arms, screaming hopelessly. She does not turn to the mother for comfort. The mother looks distant and self-absorbed. She makes an absent gesture to comfort the baby, and then gives up and looks away.

The screaming continues for five dreadful minutes. In the background, we hear Mrs. Freiberg's voice gently encouraging the mother, 'What do you do to comfort Mary when she cries like this?' The mother murmurs something inaudible. As we watched this tape later, we said to each other incredulously, 'It's as if this mother doesn't hear her baby's cries.'

Ultimately, the infant will transition out of this heightened protest into detachment. With termination of her protest, she will become silent. She'll shift out of hyperarousal and dissociate, and match her mother's state. This behavioral strategy is described by the developmental psychologists Trodd, Tronick and Weinberg as follows: "When an infant's' attempts fail to repair

an interaction, he or she often loses postural control, withdraws, and self-comforts. The disengagement is profound even with a short disruption of the mutual regulatory process, and he or she breaks into subjectivity. The infant's reactions are reminiscent of the withdrawal of Harlow's isolated monkeys, and of the infants in institutions observed by Bowlby and Spence."

The same sequential defensive operation has been observed in the psychophysiological literature by Porges, who describes it as, "a sudden and rapid transition from an unsuccessful strategy of struggling requiring massive sympathetic activation to a metabolically conservative immobilized state - mimicking death.

And so, not just the trauma, but the infant's defensive response to the trauma (the regulatory strategy of dissociation) is inscribed in his or her developing circuits. In this manner, traumatic stress in childhood could lead to self-modulation of painful affect by directing attention away from internal emotional states in later life.

Notice that this latter context is devoid of any mutually regulating interactions. Although in physical proximity, both mother and infant are simultaneously auto-regulating their stress in parallel, rather than intersecting dissociative states. There is a void of subjectivity within each, and there's a void in the communications within the inter-subjective field. In other words, there is no dyadic attachment mechanism to convey or sense signals from the other. What stands out between them, both verbally and non-verbally, is a silent void, a vacuum, a black hole of nothingness. Dissociation has been classically described as a constricted state of consciousness, therefore devoid of subjectivity.

To summarize, the state of immobilization in response to extreme terror results from conservation withdrawal. Due to this metabolic shut-down higher brain activity, including the capacities of processing external social stimuli and generating internal images, ceases. (You may recall Bessel's stunning image yesterday of the accident victim with literally no activity in her cerebral cortex.)

In Damasio's neurological model, the self is a repeatedly reconstructed biological state that endows our experience with subjectivity. But in the case of dissociation, under conditions of massive default in metabolic energy production from basic brain/mind/body functions, there is insufficient energy to reconstruct the biological state that sustains cohesion of cell function and thereby subjectivity. This regulatory failure is experienced by the infant as a discontinuity in what Winnecott calls the child's need for "going on being," and what Kestenberg refers to as "dead spots" in the infant's subjective experience. There is no subjective self in the profound detachment of dissociation. Here is what Janet describes as the breakdown in the maintenance of an integrated sense of self occurring during the period of the origin of the self.

- Furthermore, there are enduring effects of early relational trauma-induced dissociation. In a task force search, Serouf and his colleagues conclude that early trauma more than later trauma has a greater impact on the development of dissociative behaviors. They write, "The vulnerable self will be more likely to adopt dissociation as a coping mechanism, because it does not have either the belief in worthiness gained from a loving and responsive early relationship, or the normal level of defenses and integration that such a belief affords. And so, at later points of stress this personality organization will access primitive defenses, such as dissociation and projective identification.

Traumatic Attachment and Right Brain Psychopathogenesis: Main's studies, and indeed all "the strange situation" studies occur when the infants are 12 to 18 months of age - a time of right brain maturation. Research documents that disorganized attachment strategies increase in frequency from 12 to 18 months, because the toddler is now moving. This interval is critical to the experience-dependent maturation of the orbitofrontal areas of the cortex.

- Early traumatic environments interfere with the organization of right hemispheric cortical/sub-cortical circuits, and compromise such functions as the capacity to play, attachment, empathy, and affect regulation. And because of this dysfunction, affect disturbances are a hallmark of early trauma. This is because the developing infant is most vulnerable to non-optimal and growth-inhibiting environmental events, during the period of most rapid brain growth.

Excessive Orbitofrontal Pruning and PTSD: During a critical period of regional brain growth, genetic factors are expressed in an initial over-production of synapses. This is then followed by an environmentally-driven process, the pruning and maintenance of synaptic connections and the organization of circuits. The principle is - cells that fire together survive together, and wire together.

But in the case of inadequate environmental input, cell death occurs. Post, a researcher at the NIMH in Washington, reports a study of infant mammals entitled, "Maternal Deprivation Induces Cell Death." Neglect is a primary example of maternal deprivation. The dysregulating events of both abuse and neglect create chaotic biochemical alterations of corticosteroids and excitotoxic transmitters in the infant brain - a condition that intensifies the normal process of programmed cell death.

A trauma-induced developmental over-pruning of a cortico-limbic system, especially one that contains a genetically encoded underproduction of synapses, would represent a high risk condition. For example, if the connections between the orbitofrontal cortex and the amygdala (which are in an active state of growth at this time) were paired down, the orbitofrontal cortex would have little ability to regulate the amygdala.

- It is now established that psychological factors prune or sculpt neural networks in the post-natal brain. Therefore, I suggest that trauma-induced excessive pruning of the right cortical/sub-cortical circuits affects the etiology of vulnerability to later extreme disorders of affect regulation. Indeed, the specific involvement of right brain impairments in traumatized patients has been documented in brain imaging studies that reveal the pre-eminent role of right hemispheric limbic circuits as traumatic emotional memories are recalled. (Yesterday, Bessel mentioned the studies of Roush, et al.)

Heightened activity of the right hemisphere occurs upon re-experiencing visual imagery of traumatic events. But heightened activity of the right hemisphere is also seen during overwhelming and uncontrollable panic states - marked by terror and intense somatic symptoms. Due to its unique connection to the reticular formation, this hemisphere is dominant for the regulation of arousal of both the right and left hemisphere. Therefore, a dysfunction of right hemispheric arousal regulation would lead to the arousal dysregulation that characterizes traumatic states - either states of hyper-arousal or hypo-arousal.

These findings suggest that under stress the limbic system of these patients is not regulated by the right cortical areas, but by the right sub-cortical areas - specifically the right amygdala - a structure that also connects to the reticular formation and the hypothalamus. This is a structure that is specialized in processing frightening faces and what is called "unseen fear." LeDoux suggests that a defective orbital prefrontal system would result in an inability to correct the amygdala's appraisal of a threatening stimulus. And that this emotional perseveration would lead to a prolonged defensive state, and an increased resistance to an extinction of fear behaviors - such as found in anxiety, phobic, panic, and post traumatic stress disorders.

The right hemisphere is preferentially active during stress. The left hemisphere is online under mild stress conditions - but when stress dominates the situation, the right hemisphere comes online. The right hemisphere is also known to be dominant for the processing of negative states. This hemisphere is specialized for vigilance of the negative aspects of the environment, and

responds to such stimuli. It is now thought that traumatic early life experiences predispose certain individuals to later psychiatric disturbances, when they are “re-challenged” by a recurrence of the original stressor - or by a matching event. That is, when something similar to the stressor appears, the original trauma is triggered.

As previously mentioned, the right brain imprints the abusive caregiver’s threatening face into procedural memory. That is, the visual/spacial right hemisphere contains a non-verbal affect lexicon of facial expressions that are imprinted during mother/infant affective transactions. This hemisphere appraises facial expressions at levels beneath awareness in under 50 milliseconds - and if a match occurs with a stored image, an affective response will immediately be triggered.

- Autonomic changes in the body are evoked when angry facial expressions are subliminally presented to the right hemisphere - but not to the left hemisphere. I suggest that visual stressors (especially non-conscious perceptions of images and sounds of threatening and humiliating faces) are potent triggers of dysregulation in patients with traumatic attachment disorders.

As mentioned, the right brain circuitry that is involved in intense emotional homeostatic processes (and in the modulation of primary emotions) is organized in the first two years of life. Exposure of the early right brain to extensive and long enduring traumatic states interferes with this organization, and predisposes the disorganized, disoriented infant (and later the unresolved, disorganized adult) to a vulnerability to develop chronic difficulties in affect regulation when under stress. The resulting regulatory failures would cause a personality organization with a limited capacity to modulate either by auto-regulation or interactive regulation (with someone else) the intensity and duration of right brain biologically primitive affects - specifically terror, rage, excitement, elation, shame, disgust, and hopeless despair. Notice that joy is also a stressor to these personalities.

The right hemisphere is more interconnected to the autonomic nervous system than the left. And these connections also form during infancy. Thus early traumatic abuse, and/or neglect, would drastically reduce such CNS/ANS connections, and lead to an inefficient modulation of the ANS by the higher CNS. As a result, the sympathetic and parasympathetic components could not operate reciprocally. That is, increases in activity in one division would not be offset by decreases in the other. This means that under stress there would not be a counter-balancing mechanism thereby allowing concurrent increases in both divisions - causing a condition of simultaneous excitation and inhibition. This would be like riding the gas and the brake at the same time resulting in an extremely high state of sympathetic, plus parasympathetic arousal.

- This non-reciprocal ANS pattern is seen in the freeze reaction of Type D infants, in the frozen watchfulness observed in abused children, and in the frozen state of terror seen in adult PTSD patients. Kaylin’s primate research shows that freezing in infants (which is elicited by eye contact) correlates with extreme right frontal EEG activity and high basal cortisol levels - and endures as a fearful temperament.

An altered maturation of the right frontal system would lead to a disruption of its function in coordinating the two branches of the autonomic nervous system. Therefore, a rapid uncoupling of the ANS would occur in response to even low levels of interactive stress, and be expressed in emotional lability and rapid shifts of state. This would cause a cycling between intrusive hyper-sympathetically driven terrifying flashbacks, and traumatic images - and para-sympathetically driven avoidance, numbing and dissociation.

Putnam describes pathological dissociative switches between states (which occur rapidly) manifesting in inexplicable shifts in affects, discontinuities in train of thought, and changes in facial appearance, speech and mannerisms. Borderline personalities, who show high levels of dissociation, manifest these oscillations. Dissociation, which has been called “submission and

resignation to the inevitability of overwhelming, even psychically deadening danger” may be a much more common phenomenon of the psychopathology of everyday life than previously thought. On the adult attachment inventory, a classification of “unresolved” (which is the adult, disoriented, disorganized analogue) - is made when an individual’s narrative of his early experiences show lapses in monitoring, and prolonged silences of 20 seconds in these micro-dissociative processes. Again, I would say that what is pathological is not only the excessive use of dissociation, but also an inability to shift out of a dissociated state (staying dissociated for long periods of time), and therefore being impermeable to any forms of interactive contact.

Liotti has described that patients using dissociation “often oscillate quickly between clinging to the therapist, and emotionally withdrawing from the therapist - becoming frightened as if expecting to be assaulted by him or her. Sometimes these incompatible types of interpersonal behaviors take place almost simultaneously within a single session. In such cases, the patient may show a dazed trance-like expression, while shifting from one attitude to another.” Liotti says, “This is strongly reminiscent of the disorganized, disoriented behaviors observed in traumatized infants.” Thus, prolonged episodes of intense and unregulated interactive traumatic stress during an early critical period of maturation, results in a developmentally immature right brain.

In neuropsychological studies, Tischer concludes that early traumatic experiences negatively impact the development of the right hemisphere, and it’s connections to the left hemisphere. I suggest that relational trauma (especially in the second year) would induce a severe pruning of the right hemispheric colossal axons that are growing towards their counterparts in the left hemisphere - and therefore emotional states that are processed by the right hemisphere could not reach the left hemisphere, resulting in feelings without words.

Stated in another way, you now have an organization between the two hemispheres in which facial expression, bodily states, and affective information implicitly processed by the right brain are inefficiently sent to the left brain for further explicit semantic, declarative processing. Developmental studies demonstrate that maltreated toddlers show a dramatic inability to talk about their emotions and internal states in the second year, and I’m suggesting that this represents the early expression of alexythymia. There are now clinical and experimental studies of a right-brain affect regulating dysfunction in alexythymia - a condition common to early traumatic attachment pathologies.

I want to stress at this point that I do not believe that only trauma in the first two years of life is psycho-pathogenic or self-disorganizing. What I am saying is that when a particular individual appraises to be stressed, how he or she characteristically, consciously, and especially unconsciously responds to stressors, and how efficiently he or she psychobiologically copes with these stressors is uniquely and indelibly influenced by the events of infancy. What’s more, and equally important, these early, primordial interactive experiences determine whether or not in later times of crisis the individual can allow him- or herself to seek interpersonal support from others - that is, to avail himself of interactive regulation within an intimate or psychotherapeutic relationship when his own auto-regulatory mechanisms have temporarily failed.

- In closing, I want to say a few words about the implications of this psycho-neurobiological model of emotional development for the treatment of trauma patients. You may recall, the psychoanalyst pediatrician Winnicott’s dictum that the clinical encounter in whatever form of treatment is always a mutual experience. In this connection, he said, “In order to use the mutual experience, one must have in one’s bones a theory of the emotional development of the child and the relationship of the child to the environmental factors.”

The arena of therapeutic encounters for the treatment of trauma spans the gamut from EMDR techniques (that directly tap into visual/spacial working memory and reduce the vividness and emotional charge on traumatic images), to EEG biofeedback training (that directly alters brain activity in order to reduce the symptoms of anxiety), to somatic therapies (that desensitize

autonomic-hyperarousal), to pharmacological approaches (that alter states by acting on limbic receptors of arousal-regulating through biological means), to repetitive transcranial magnetic stimulation (that attempts to normalize right prefrontal metabolism), to current interactional psychotherapies (that focus on preverbal mechanisms of affect regulation stored in implicit procedural memory).

Longer-term psychotherapy is directed towards the completion of interrupted developmental processes, and allows for the evolution of affects from their early form (in which they are experienced as bodily sensations) into subjective states that can gradually be verbally articulated - and lead to the creation of meaning of the traumatic event or events.

What is common to all these interventions is that they all share what are known as “non-specific treatment factors.” I suggest that these factors, which are embedded in the concept of the therapeutic alliance, can now be identified with the dynamic operations of the right brain - as it interacts with the right brain of another person. Furthermore, as Susan Bradley, a Toronto psychiatrist points out in her new volume, “All therapies, including EMDR, show a similarity in promoting affect regulation.”

Thus trauma-focused treatments all share the common goal of directly altering the activity and structure of the right brain, especially the right orbitofrontal system. This system is centrally involved in the implicit processing and regulation of bodily states, in processing feedback information and the correction of emotional responses at the highest level of control of emotion, as well as in the association of emotion with ideas and thoughts - and in the processing of affect-related meanings.

In summary, the orbitofrontal cortex is the substrate of emotion-related learning - and I suggest that psychotherapy is emotion-related learning. The orbitofrontal areas are the most plastic areas of the cortex, and therefore contain the possibility for structural change. A recent fMRI study at UCLA provides evidence that “higher regions of the right prefrontal cortex attenuate emotional responses at the most basic level in the brain.” These regions have modulating processes that the authors say are “fundamental to most modern psychotherapeutic methods” and that this lateralized neocortical network is active in modulating emotional experience through labeling emotional expressions. They further state that “this form of modulation may be impaired in various emotional disorders, and may provide the basis for the therapies of these same disorders.”

This chart shows right frontal activation at a time when a negative emotion is felt, and then verbally labeled. These findings, along with earlier data, indicate that affect regulation is a central process in psycho-biological development, brain organization and psychotherapy.

As important as these interventions are, this developmental model has additional significant implication for the mental health professions. The structural organization of the brain regions that will come to mediate the individual's essential coping mechanisms are also organized in a critical period of infancy. The construct of “critical periods” implies that certain detrimental early influences lead to particular irreversible enduring effects (or only partially reversible effects) - thus highlighting the fact that constraints of biological organizations become set in place, once systems differentiate. The flip side of the critical period concept emphasizes the extraordinary sensitivity of developing dynamic systems to their environment, and asserts that these systems are most plastic in periods when they are developing.

In summary then, the development of the right brain is experience dependent, and this experience is embedded in the attachment relationship.

Clinicians have theoretical and personal knowledge of how the emotional relationship between the patient and therapist mediates symptom reduction and personal growth. These same interpersonal skills and inter-subjective sensitivities would also be valuable assets in prenatal and

postnatal preventive programs. For the entire lifespan, the right hemisphere is centrally involved in enabling the individual to cope actively and passively with stress.

In light of the fact that the right brain is in a growth spurt from the last trimester of pregnancy through the second year of human life, therapeutic interventions with pregnant women and new mothers would have life long effects on the adaptive capacities of a developing self. In fact, infant mental health workers are now devising interventions that effectively alter parenting skills, and thereby the attachment experiences and neurobiological capacities of high risk infants.

EMDR applications to traumatized dyads could add significantly to these efforts. Such developmentally oriented programs, if expanded to a larger social scale, could make deep inroads into not only preventing early trauma but altering the inter-generational transmission of psychopathology, and thereby make a major contribution to the problems that our societies are now facing.