TOWARD AN INTERPERSONAL NEUROBIOLOGY
OF THE DEVELOPING MIND:
ATTACHMENT RELATIONSHIPS, “MINDSIGHT,”
AND NEURAL INTEGRATION

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- This article reviews findings exploring the idea that the mind develops at the interface between human relationships and the unfolding structure and function of the brain.

- The brain is directly shaped by interpersonal experiences. This “interpersonal neurobiology” (Siegel, 1999) presents an integrated view of how human development occurs within a social world.

- This framework suggests some basic principles for conceptualizing the essential experiential ingredients that may facilitate the development of the mind, emotional well-being, and psychological resilience during early childhood and perhaps throughout the lifespan.

- At the core of these processes is a fundamental mechanism of integration which can be seen at a variety of levels, from the interpersonal to the neurological.

- Integration may be conceptualized as the basic process that secure attachments facilitate in promoting psychological well-being.

EXPERIENCE, MIND AND BRAIN

- The infant is born into the world genetically programmed to connect with caregivers who will become “attachment figures” in the child’s life (Cassidy & Shaver, 1999). These attachments can be formed to the mother, to the father, and to other individuals who are intimately involved in providing care for the growing child.

- Attachment is considered a basic, in-born, biologically adaptive “motivational system” that drives the infant to create a few, selective attachments in his life. These attachments provide a relationship in which the infant will:

  1. seek proximity to the attachment figure;
  2. have a sense of a safe haven—in which when he is upset the attachment figure will soothe his distress; and
  3. develop an “internal working model of a secure base”—an internal schema of the self with the other, self-with-attachment-figure—that will provide him with a security enabling
him to explore the world, have a sense of well-being, and to soothe himself in times of distress in the future (Bowlby, 1969).

- Though the attachment system is “hard-wired” in the brain, the experiences that an infant has will directly shape the organization of that system.

- Experience involves the activation of neurons in the brain that respond to the sensory events from the external world—or to the internally generated images created by the brain itself (such as our experience of recalling times from the past) (Gazzaniga, 1995; Kandel & Schwartz, 1992).

- Another important general point is this: although we focus on particular regions and circuits of the brain, the fact is that the brain is a complex set of integrated systems that tend to function together.

- The mind is created from the whole brain.

- “Integration”—the ways in which functionally distinct components come to be clustered into a functional whole—may be a fundamental way in which the nervous system functions.

- When certain suboptimal attachment experiences occur, the mind of the child may not come to function as a well integrated system.

- Important interpersonal elements of communication help to foster, or to hinder, the development of such neural integration.

- Integration is a core process essential for mental well-being within the individual and the family, and perhaps fundamental for the healthy functioning of a nurturing community (The Developing Mind, Siegel, 1999).

DO ATTACHMENT RELATIONSHIPS INFLUENCE BRAIN DEVELOPMENT?

- Both genetically encoded information and neural activation itself can result in the activation of genes that leads to the creation of the proteins necessary to shape the structure of the brain (Kandel, 1998; Nelson & Bloom, 1997).

- Experience shapes the function of neural activity in the moment, and can potentially shape the continually changing structure of the brain throughout the lifespan.

- Findings from neuroscience suggest that the brain remains plastic throughout life (Barbas, 1995; Benes, 1998).

- The capacity for attachment classifications to change beyond the early years of life may be related to this ability of the brain to continue to grow in response to experiences across our life times.

- A number of indirect analyses suggest that attachment classifications are determined primarily by relationship experiences and not by genetic inheritance.
Several findings point to the experiential role of relationships, rather than that of genetic information, in determining attachment status.

Development is an ongoing process, and so close, emotionally involving relationships may continue to influence us throughout the lifespan.

Disuse (‘use-it-or-lose it’) or toxic conditions, such as with excessive stress (as in child abuse), can lead to the elimination of existing synapses.

A contrasting process, sometimes called “experience-dependent” development, occurs by way of the establishment of new neural connections induced by experience.

Experience, therefore, can alter brain structure by leading to either the maintenance and strengthening of existing synapses, or by the experience-driven creation of new synaptic connections.

The generally held belief in neural science is that the patterns of neuronal connections determine the ways in which the brain functions and the mind is created.

“Human connections create the neural connections from which the mind emerges” (Siegel, 1999). It is in this manner that interpersonal experiences directly shape the genetically driven unfolding of the human brain.

There is no need to bombard infants or young children (or possibly anyone) with excessive sensory stimulation in hopes of “building better brains.”

More importantly than excessive sensory stimulation in the early years of development, are the patterns of interaction between child and caregiver.

Attachment research suggests that collaborative interpersonal interaction, not excessive sensory stimulation, can be seen as the key to healthy development.

Because of the ongoing creation of synapses in response to experience and the early excessive growth of new synapses, which eventually become pruned to adult levels by the end of puberty, it is clear that development may occur over a prolonged period of time.

Recent findings from neuroscience that the adult brain remains “plastic”—or open to changes in response to experience—throughout the lifespan in no way decreases the importance of the first years of life in establishing patterns of neuronal growth that subsume very important functions.

There are circuits that are responsible for emotional and social functioning that come “on-line” during the first years of life. While this period may not be the “last chance” for ongoing development in these areas, it is a time when basic circuitry is being established for the first time.

The orbitofrontal region, which is central for a number of processes such as emotion regulation, empathy, and autobiographical memory, may have an experience-influenced development that depends upon the nature of interpersonal communication during the early years of life.

Interactions with “older people,” with attachment figures, are essential during this time to create the contingent, collaborative communication necessary for the proper emotional and social development of the child.
It is not a matter of overwhelming “enrichment” or excessive sensory stimulation that is needed during this time, but one of attunement between adult and child. This collaborative, attuned communication establishes patterns of interaction by which the caregiver can regulate the child’s positive and negative emotional states.

These emotion-regulating interactions are required for the experientially influenced maturation of the infant’s developing emotional and Social brain.

**BRAIN DEVELOPMENT AND MEMORY**

During the early years of life, the basic circuits of the brain are developing which will be primarily responsible for a number of important mental processes involving emotion, memory, behavior, and interpersonal relationships (Schore, 1994, 1996, 1997).

These processes include the generation and regulation of emotion, the capacity for “response flexibility” or mindful, reflective behavior (Siegel, 1999), the autobiographical sense of self and the construction of a “self-narrative,” the capacity to understand and care about the minds of others, and the ability to engage in interpersonal communication.

Independent studies in attachment suggest that patterns of interaction between caregiver and child have an important impact on the development of these mental processes (Cassidy & Shaver, 1999; Toth, Cicchetti, Macfie, & Emde, 1997).

Development shapes the brain by altering the strength of the synaptic connections within the brain. These alterations can take a number of forms.

Regardless of the origin of the synapse, genetic information, toxic substances, and stressful or absent experiences can lead to the elimination of synapses.

Memory is the way in which past experience is encoded in the brain and shapes present and future functioning (McClelland, 1998; Milner, Squire, & Kandel, 1998).

For the first year of life, the infant has available an “implicit” form of memory that includes emotional, behavioral, perceptual, and perhaps bodily (somatosensory) forms of memory.

When implicit memories are activated, they do not have an internal sensation that something is being recalled. They merely influence our emotions, behaviors, or perceptions directly, in the here and now, without our awareness of their connection to some experience from the past.

By the middle of the second year, children begin to develop a second form of memory, “explicit” memory (Bauer, 1996).

Explicit memory includes two major forms: factual (semantic) and autobiographical (“episodic”) (Tulving, Kapur, Craik, Moscovitch, & Houle, 1994).

- For both types of explicit memory, recollection is associated with an internal sensation of “I am recalling something now.”
- For the later developing autobiographical memory, there is also a sense of the self at a time in the past.
One of the important messages of these findings is that although we may never recall “explicitly” what happened to us as infants, the experiences we had with our caregivers have a powerful and lasting impact on our implicit processes.

These experiences, as we have seen, involve our emotions, our behaviors, our perceptions, and our mental models of the world of others and of ourselves.

Implicit memories encode our earliest forms of learning about the world.

Implicit memories directly shape our here-and-now experiences without clues to their origins from past events.

Attachment research, combined with modern studies of genetics and developmental neurobiology, suggests that specific kinds of communication within emotionally connected relationships appear to offer the most important experiential world in which the child’s mind can develop. This perhaps is best seen in ways of understanding the development of the self.

THE DEVELOPMENT OF “SELF” AND HUMAN RELATIONSHIPS

When we think about psychological development, about the developing mind, it is helpful to think about what the “psyche” actually is.

There is an entity called the psyche or the mind that is as real as the brain, the heart, or the lungs, although it cannot be seen directly with or without the aid of microscopes or other tools of modern technology.

One definition of the psyche is: “1. the human soul; 2. the intellect; 3. psychiatry—the mind considered as a subjectively perceived, functional entity, based ultimately upon physical processes but with complex processes of its own: it governs the total organism and its interaction with the environment” (Webster’s, 1996).

Many views converge upon the notion, paralleled by studies of implicit memory, that the brain creates a “here-and-now” experience of self.

The core self may be subject to huge degrees of impact by the environment.

- For example, if the environment is one of trauma and stress, the core self will be impacted to a great degree.
- The sense of agency, coherence, affectivity, and even continuity (memory) of the self in interaction with others will be severely impaired in cases, for example, of familial child abuse (Siegel, 1995, 1996).

The deepest sense of self awareness, of core consciousness, may be profoundly influenced by early experiences in infancy even before explicit, autobiographical memory is available.

This neurological view of the creation of a core self experience may also help us to understand the profound importance of collaborative, contingent communication in the development of the infant, and perhaps normal functioning throughout the lifespan.

Secure attachments are created within a mutually resonant form of interpersonal communication.
The alignment of states of mind inherent in contingent communication enables the core self of each member of an interacting dyad to have a sense of “fullness”

The contingency of the transaction within collaborative relationships enables the ever evolving core self to have a sense of coherence.

The subsequent collaborative changes create a core self-experience that is coherent and inherently defined as connected to another person

In this fundamental neural manner, interpersonal connections can be seen to create the self. When these interpersonal connections are contingent, the self becomes integrated and coherent.

One aspect of the self is that of autonoesis, or “self-knowledge,” as revealed in autobiographical narratives.

Attachment research has established that one of the most powerful predictors of an infant’s attachment to the parent is the parent’s autobiographical narrative coherence (Hesse, 1999).

Narrative coherence can be examined by determining the free and flexible flow of information as individuals tell the story of their lives, beginning with the memories they recall of their earliest experiences.

The Adult Attachment Interview

The research instrument utilized to assess this coherence is the Adult Attachment Interview (see Hesse, 1999; Main, 1995). The Interview is a narrative review by the parent of her recollections of her earliest relationship experiences with her own parents.

One can view such autobiographical accounts as revealing the capacity of the mind to achieve a certain amount of integration of functioning.

This integration appears to allow the individual to have an internal sense of connection to the past, to live fully and mindfully in the present, and to prepare for the future as informed by the past and the present.

ATTACHMENT AND THE DEVELOPING MIND

Why should such a coherent self-reflective process of the parent be associated with the child’s security of attachment?

Securely Attached

Longitudinal attachment studies have found that securely attached children appear to have a number of positive outcomes in their development (Cassidy & Shaver, 1999).

These include enhanced emotional flexibility, social functioning, and cognitive abilities.

Some studies suggest that security of attachment conveys a form of resilience in the face of future adversity.
Insecure Attachments

- In contrast, a number of studies suggest that the various forms of insecurity of attachment can be associated with emotional rigidity, difficulty in social relationships, impairments in attention, difficulty in understanding the minds of others, and risk in the face of stressful situations.

- Suboptimal attachment experiences may predispose a child to psychological vulnerability in part by altering the brain’s neuroendocrine response to stress (Liu et al., 1997; Rosenblum, Coplan, Freidman, Basoff, Gorman, & Andrews, 1994).

Disorganized/Disoriented Attachment (“Traumatic Attachment”)

- One form of insecurity of attachment, called “disorganized/disoriented,” has been associated with marked impairments in the emotional, social, and cognitive domains. Individuals with this form of attachment have also been demonstrated to have a predisposition toward the clinical condition of dissociation in which the capacity to function in an organized, coherent manner is at times impaired (Carlson, 1998; Liotti, 1992; Main & Morgan, 1996; Ogawa, Sroufe, Weinfeld, Carlson, & Egeland, 1997).

- Recent studies have also found that youths with a history of disorganized attachments are at great risk of expressing hostility with their peers and have the potential for interpersonal violence as they mature (Lyons-Ruth, Alpern, Repacholi, 1993; Lyons-Ruth & Jacobwitz, 1999).

- This disorganized form of attachment has been proposed to be associated with the caregiver’s frightened, frightening, or disoriented behavior with the child (Main & Hesse, 1990). The parents of these children often have an Adult Attachment Interview finding of “unresolved trauma or grief” that appears as a disorientation in their narrative account of their own childhoods (Hesse, 1999).

- What this implies is that the lack of resolution of trauma or loss in a parent can lead to parental behaviors that create “paradoxical,” unsolvable, and problematic situations for the child.

- The attachment figure is intended to be the source of joy, connection, and emotional soothing. Instead, the experience of the child who develops a disorganized attachment is such that the caregiver is actually the source of alarm, fear, and terror, so the child cannot turn to the attachment figure to be soothed (Main & Hesse, 1990).

- This finding provides important insights into the nature of the transmission of trauma across the generations. Helping such individuals resolve their traumatic experiences and losses may be an important therapeutic intervention in attempting to alter the course of devastation that such transgenerational trauma can create.

- Several basic elements of interpersonal relationships are likely to foster emotional well-being and psychological resilience.
Although derived from research studies in attachment, these ideas may also be useful for understanding the impact of close, interpersonal relationships of all sorts throughout the lifespan.

This requires that we address the basic needs of the young child to have the opportunity to develop secure attachments with caring, consistent, and reflective adults in addition to her own parents.

Fortunately, the infant’s mind appears to be quite capable of creating a secure attachment to a selective few adults besides the parents.

- Grandparents and other relatives, daycare providers, nannies, and other individuals who are “caregivers” for a child may all play important roles as attachment figures.

Understanding a child’s individual needs and style of communicating, taking joy in the child, and being able to soothe the child when he is in distress, are each basic components of the child’s relationship with the attachment figure.

The following are five basic elements of how caregivers can foster a secure attachment in the children under their care.

1. **Collaboration.** Secure relationships are based on collaborative, contingent communication.
   - The signals sent by each member of an attuned dyad (a pair of individuals) are directly responsive in quality and timing with each other.
   - These attuned communications often have their foundation in the nonverbal signals that are shared between two individuals. Eye contact, facial expression, tone of voice, bodily gestures and timing and intensity of response are all fundamental aspects of nonverbal signals.
   - These primary emotions can be seen as the “music of the mind”
   - Each person may come to “feel felt” by the other.

2. **Reflective Dialogue.** Secure attachment relationships may involve the verbal sharing of a focus on the internal experience of each member of the dyad.
   - Attachment figures recognize the signals sent by the child, attempt to make sense of them in their own minds, and then communicate to the child in such a manner that creates “meaning” for the child in the shared dialogue about the mental states of the child and of the caregiver.
   - Internal experience, or “states of mind,” can involve emotions, perceptions, thoughts, intentions, memories, ideas, beliefs, and attitudes.
   - By directly focusing on these aspects of mental life, the adult can create a sense that subjective experience is both important and can be communicated and shared.
   - In this manner, the “mind” itself becomes a central focus of sharing in the discussions between two minds.
   - Such a meaning-making process coupled with collaborative, reciprocal communication allows the child to develop “mindsight”: the capacity of the mind to create the representation of the mind of others, and of the self (Siegel, 1999).
3. Repair. When attuned communication is disrupted, as it inevitably will be, repair of the rupture is an important part of reestablishing the connection within the dyad.

- Repair is healing. Repair is also important in helping to teach the child that life is filled with inevitable moments of misunderstandings and missed connections that can be identified and connection created again.
- Such interactive repair allows the child to make sense of periods of painful disconnection and create a sense of meaning out of the understanding of one’s own and another’s mind.
- An adult’s pride may at times inhibit repair and leave the child isolated in what may be a shameful state of disconnection. Intense uncomfortable emotional states in the child or parent may lead to a disconnection in collaborative communication.

4. Coherent Narratives. The connection of the past, present, and future is one of the central processes of the mind in the creation of the autobiographical form of self-awareness.

- An adult without a coherent autonoetic process may be at risk of providing interactive experiences for a child that produce various forms of insecure attachment.
- Adults with a flexible capacity to integrate their experiences across time appear to also be able to provide integrating interpersonal communication with their children.
- Adults can teach children about the world of the self and of others by joining with them in the co-construction of stories about life events.

5. Emotional Communication. Attachment figures can amplify and share in the positive, joyful experience of living. Equally important is the attachment figure’s ability to remain connected to the child during moments of uncomfortable emotion.

- These heightened moments of sharing a sense of vitality are important in creating the foundation for a positive attitude toward the self and others.
- Negative emotional states can be shared as the adult then helps the child to reduce these states and soothe his distress. Helping a child learn that he will not be emotionally abandoned during these moments and that he can learn to understand and soothe his painful emotional state is an important role for the attachment figure to play.
- Adults also need to be sensitive to a child’s cycling needs for direct connection and for solitude. Awareness and respect for these changing needs for connection are a part of emotionally attuned communication.

Emotions

- Attachment relationships differ in the ways in which states of mind and emotional communication are shared between parent and child (Siegel, 1999). Distinct patterns of emotional communication characterize each of the differing attachment classifications.
- The emotional processes of the more mature adult mind can be used by the child to regulate her own internal state.
- From the beginning of life, “self-regulation” is actually determined in part by an interactive “dyadic” process of mutual co-regulation (Feldman, Greenbaum, & Yirmiya, 1999; Hofer, 1994; Sroufe, 1996).
A child uses the state of mind of the parent to help organize her own mental processes.

These transactions involve cognitive processes (such as appraisal or the evaluation of meaning) and physical changes (such as endocrine, autonomic, and physiological).

**INTERPERSONAL COMMUNICATION AND THE DEVELOPMENT OF MINDSIGHT**

The mind of the child appears to develop a core manner in which the mental states of other individuals become represented within the neural functioning of the brain (Stone, Baron-Cohen, & Knight, 1998).

In the child’s early life, emotional interactions with attachment figures appear to be of primary importance in shaping the core (here-and-now) and autobiographical (past-present-future) senses of self.

One form of neural map is the way in which the brain creates images of other minds. I have used the term “mindsight” to refer to this representational process. In essence, this is the capacity of one mind to “perceive” or create representations of the mind of oneself or of another (Aitken & Trevarthen, 1997).

The basic elements of mind that are “seen” can include thoughts, feelings, perceptions, beliefs, attitudes, intentions, and memories. Such a complex capacity develops throughout childhood, and can become continually more enriched throughout the lifespan.

Other authors have described similar processes using terms such as mentalizing, reflective function, theory of mind, and social cognition (Fonagy & Target, 1997).

In some neurologically impaired individuals, the capacity for mindsight may be disturbed, such as in children with the disorder of autism (Baron-Cohen, 1995).

In some cases of intrusive parenting, children also have been shown to have diminished mentalizing abilities (Fonagy & Target, 1997). This suggests that the capacity for mindsight develops from within the intact neurological structures of an individual who experiences a certain degree of collaborative, nonintrusive attachments.

What we do know from the independent field of studies in child development is that certain attachment experiences appear to promote socially adaptive, morally responsible behaviors in children.

One way of thinking about these secure attachments is that they involve the basic elements discussed earlier, and have as their foundation the ability of the adult to create a collaborative form of communication with the child. But how can a logical, word-oriented adult communicate with a primarily right-hemisphere dominant nonverbal infant to help with the earliest stages of the development of these important functions?
The nonverbal interactions of caregiver and infant can be proposed to be the most important elements that help to create a secure attachment between the infant and the caregiver at the beginning of life.

As the child grows, as discussed above, reflective dialogues that help create meaning and interpret the complex world of human minds for the child are extremely important.

Such reflective, meaningmaking dialogues require, we can propose, an integrated right and left hemisphere in both caregiver and child. But adults often live in a logical world filled with word-dominated thoughts. These left-hemisphere processes are often far from the more subtle, nonverbal experiences that the adult needs to be able to share with the infant. In essence, the infant’s brain needs to “feel felt” by the caregiver.

Such a feeling of connection, in fact, may be extremely important for each of us in our relationships throughout the lifespan. Collaborative communication is far more than the sharing of linguistic packets of verbally understood words.

We can propose that within the child’s brain is created a multisensory image of the emerging caregiver’s nonverbal signals. These nonverbal signals reveal the primary emotional states of the individual’s mind. These primary emotions, the music of the mind, are the most direct way in which the nonverbal, subjective state of one’s current mental processing can be externally expressed to another person. Such primary emotions are the profiles of activation, the flows of energy and nonverbal information, that reveal the primary essence of one’s mind.

It is in this manner that emotionally attuned communication, the resonant sharing of nonverbal signals, allows for the child to “feel felt” and to create a secure attachment with that connecting adult.

It is the sharing of these nonverbal expressions of primary emotions that allows for the most direct connection of one mind to another. Within such attuned, collaborative experiences the securely attached child’s core self is then able to reflect a coherence between the self and the “other.”

This defining focus of the self as a “self-with-attuned-other” is, I believe, the developmental origins of our natural capacity for caring about and feeling connected to others in the world.

The heart of the emotional transactions with the growing child can be described as being the sharing and amplification of positive emotional states, and the sharing and reduction of negative states.

These repeated and reliable emotional transactions allow a child to feel connected in the world. It is also these communications that allow a child to initially rely on the caregiver for help in regulating her own emotions, and then later to develop a more autonomous form of flexible self-regulation.

In this manner attuned emotional communication within secure attachments leads to a healthy and flexible capacity for self-regulation.

COMPLEXITY, COHERENT NARRATIVES, AND NEURAL INTEGRATION
To understand the links among interpersonal communication, personal narratives, and self-regulation, it is helpful to examine the experience of mind from the perspective of complex systems.

The application of “complexity theory” or the “nonlinear dynamics of complex systems” to the human mind has been useful in understanding the processes of development and of human experience (Cicchetti & Rogosch, 1997b; Fogel, Lyra, & Valsiner, 1997; Globus & Arapia, 1993; Lewis, 1995, 1997; Robertson & Combs, 1995; Thelen, 1989). Complexity theory examines the ways in which the flow of the states of activation of a system has self-organizational properties, movement toward maximizing complexity, and recursive, self-reinforcing processes. Application of these principles to the layers of systems, from neural circuits to interpersonal relationships, can provide useful insights into the bridges across these levels of analysis.

Development can be seen as a movement toward ever more complex states of processing over the lifespan (Thelen, 1989).

Secure attachments enable resonant interpersonal connections in that they foster the blend of differentiation of each individual with the integration of each person within collaborative, contingent forms of emotional communication.

Human relationships that encourage both individual differences (differentiation), and interpersonal collaboration (integration) may nurture the most complex states.

Nonlinear dynamics suggests that systems that move toward such complexity are in fact the most stable, flexibly adaptive, and capable of a wide range of “self-organizing” processes.

Within secure attachments, such self-organization may be seen as the ultimate gift that caregivers offer to their children: to enable the self to achieve differentiation and integration in acquiring flexible and adaptive means for self-regulation.

We can propose that the brain is structured with an innate capacity to transcend the boundaries of the skin of its own body in integrating itself with the world, especially the world of other brains. This linkage permits mindsight and creates the capacity for compassion.

Under certain situations, the neurological foundations for mindsight may be compromised and the sense of integration with others may be impaired.

- With some neurological conditions, such as sensory impairment, caregivers may be especially challenged to provide the kind of connecting, collaborative communication that allows the child to “feel felt,” make sense of the internal world of minds, and create the capacity for mindsight.
- In other situations, suboptimal caregiving may not have fostered the development of a coherent sense of a core or autobiographical self.

We can view these situations as being the inadequate development of a coherent sense of another’s mind within the mind of the child.

Such interactions are “incoherent,” and fail to facilitate the child’s own integrative processes.

The fundamental outcome of such nonintegrative states can be seen as an impairment in self-regulation.
UNRESOLVED STATES, DISORGANIZED ATTACHMENT, AND IMPAIRMENTS TO INTEGRATION

- One form of impaired integration and self-regulation can be seen within the minds of those individuals with unresolved trauma or grief.

- In this situation, we can propose, the mind has been unable to integrate various aspects of the overwhelming experiences of trauma or loss.

- With this unresolved condition, an adult’s mind may be vulnerable to entering “altered states” in interaction with others, especially with children. These states may be considered “lower mode states” (Siegel, 1999) in which the functioning of the integrating prefrontal regions becomes temporarily impaired and behavioral output is driven more by the emotional states and impulses of the lower regions of the brain without the more reflective, rational processes of the higher, neocortical inputs.

- In this “low-road” state, the caregiver may be more likely to offer the child the frightened, frightening, or disorganizing interactions that have been proposed by Main and Hesse (1990) to be at the root of disorganized attachments.

The term “response flexibility” (Siegel, 1999) can be used to describe an important integrative process mediated by the orbitofrontal region of the prefrontal cortex. Response flexibility refers to the capacity of the brain to respond to changes in the internal or external environment with a flexibly adaptive range of behavioral or cognitive responses. A number of studies point to the central role of the orbitofrontal region in carrying out such a capacity (Mesulam, 1998; Nobre et al., 1999). One can propose that this ability requires the integrative capacities of the orbitofrontal region to functionally link elements from widely distributed input and output circuits. This region is uniquely positioned to link the major regions of the brain, including the associational cortex, limbic circuits, and brain stem areas. In this manner, the orbitofrontal region enables the more complex “higher order” abstract processing of the neocortex to be integrated with the “lower order” somatic and emotional functions of the deeper structures. Autonoetic consciousness may reveal one example of this “higher mode” of integrative processing, one that permits mental time travel and a deep sense of self awareness.

- One extension of this view is that the mind is capable of a mode of information processing that does not involve the higher mode of processing. In this “lower-mode” or “low-road” processing state, response flexibility is suspended along with other integrative functions such as autonoetic consciousness and impulse control.

- In this lower mode, behaviors become reflexive, and the mind becomes filled with deeply engrained, inflexible patterns of response. In such a condition, emotions may flood the mind and make rational thought and mindful behavior quite impaired. We can propose that one aspect of unresolved trauma or grief is to make such a lower mode of processing more likely to occur.

- Although each of us may be vulnerable to entering such low-road states, unresolved conditions may make entry into these states more frequent, more intense, and more likely to occur with minimal provocation. Recovery from such states may also be especially difficult in unresolved traumatic conditions. In this situation, the individual may remain “on the low road” for more extended periods of time as well as with increased frequency.
Entry into such lower-mode states may produce excessive emotional reactions, inner turmoil, dread, or terror, as well as an ensuing sense of shame and humiliation.

In such conditions, the individual may be prone to “infantile rage” and aggressive, intrusive, or outright violent behavior. The entry into such states directly impairs the capacity of the individual to maintain collaborative communication with others. In this way, the tendency to have an impairment in response flexibility and autonoetic consciousness within lower mode states may be at the core of how parents with unresolved trauma engage in the frightened and/or frightening behaviors that lead to disorganized attachment in their offspring.

Lower-mode states do not allow for the sensitive, contingent communication that secure attachments require. This may be the core feature of the transfer of trauma and its devastating ripple effects across the generations.

Unresolved trauma or grief, as revealed in the Unresolved/Disorganized category of the Adult Attachment Interview, can thus be proposed to reveal a fundamental lack of neural integration within the adult’s brain. The process of resolution may involve the achievement of a more integrated form of functioning that makes these lower-mode states less likely to occur. During the resolution process, if such disconnected experiences do continue, we would anticipate that the adult would be more readily able to identify them and carry out the essential interactive repair that secure attachments require. As psychotherapeutic interventions promote neural integration, we can imagine that the integrative prefrontal region may become more actively involved in the global functioning of the individual. Resolution would involve the repair of impediments to flexible self-regulation and coherent autonoesis.

In this manner, we can see that impaired internal integration may lead to impaired interpersonal integration.

One can see that the general approach to psychotherapy for individuals with unresolved trauma and grief would be to attempt to enhance the mind’s innate tendency to move toward integration, both within the brain and within interpersonal relationships.

The caregiver’s ability to engage in attuned, collaborative communication will be greatly enhanced through the resolution process.

Therapeutic improvement would be revealed as a more adaptive flexibility of the mind to respond to changes in both the external and internal worlds. An increased capacity to experience a broader range and higher intensity of emotion would emerge, with the caregiver becoming more able to connect with the child on a nonverbal, emotional level.

Overall, these changes would reflect not only the freedom from a disorganized sense of self across time as revealed in intrusive shifts in states of mind during lived daily life and within autobiographical reflections, but also the enhanced capacity of the individual to achieve integration (internal and interpersonal) and thus more adaptive and flexible self-regulation.

**REFLECTIONS ON INTEGRATION AND MENTAL HEALTH**

The finding that the coherence of the adult’s autobiographical narrative is the most robust predictor of the child’s attachment with the parent can help us shed light on the importance of neural integration for both mental health and nurturing interpersonal relationships.

Coherent narratives can be seen to reflect the ability of the “interpreting” left hemisphere to utilize the autobiographical, mentalizing, and primary emotional processes of the right
hemisphere in the production of “coherent” autonoesis, or self-knowledge. The capacity to achieve such internal coherence may reveal that individual’s ability to allow for the maximal complexity to be achieved within an interhemispheric form of integration within the brain. In this manner, the spontaneous, free flow of information and energy between both of the parent’s hemispheres reflects a core process of integration that enables coherent autonoesis. Such bilateral hemispheric integration may also permit them to engage in the spontaneous dyadic communication that is the hallmark of secure attachments. Such attuned and reflective relationships rely on the spontaneous access to the representational processes of both the nonverbal and verbal hemispheres of the brain.

- Parents who can achieve such internal resonance—revealed within their coherent autobiographical narratives—will be more likely to nurture the development of such integrative processing through their attuned and reflective interactions with their own children.

The process of integration under normal conditions may yield states of activation that are more adaptive, flexible, and stable over time than nonintegrated, less complex states. As interpersonal experiences early in life shape the manner in which the child develops self-regulatory capacities, attachment patterns may instill characteristic modes of self-organization and interpersonal relatedness. Why would moment-to-moment interactions lead to lasting integrative tendencies within the child? The finding that neural systems have recursively reinforcing processes may help to understand this finding (van Ooyen & van Pelt, 1994). Neural circuits that achieve a certain degree of complexity in their structure and function appear to have self reinforcing qualities that maintain this level of complex processing. The activation of specific patterns of neuronal firing not only creates mental representations, but it also influences the nature of the complexity that the neural networks are able to achieve. Thus, integrative interpersonal interactions may produce linkages among neural networks that reinforce their very nature. It is in this way that interpersonal communication may facilitate a direct effect on the organization of the complexity of neural structure.

- The communication of emotion can be seen at the core of the interpersonal communication that facilitates integration and the maximizing of complexity.
- By linking mental processes to each other within the single mind and across two or more minds, emotion serves as the fundamental aspect of mental life that serves to “join” or “integrate” minds.
- The sense of vitality, authenticity, and resonance that arises with narrative coherence and within attuned dyadic relationships can create a deep sense of meaning and connection within oneself and with others.
- These integrative processes can be proposed to be at the core of emotional well-being and psychological resilience. The ongoing, dynamic process of integration may be fundamental to the evolving mechanisms within the life of an individual, dyad, family or community’s continual movement toward mental health.
- By examining the convergent scientific findings regarding the social nature of the growing mind, we can come to the view that shared subjective experience is one of the most important aspects of human relationships and of psychological development.
- This perspective from an interpersonal neurobiology of the developing mind yields a scientific, objective view of the importance of subjectivity in human life.

- Attachment research suggests that the mind may continue to develop in response to emotional relationships throughout the lifespan (Lichtenstein-Phelps, Belsky,&Crnic, 1998).
- These changes in the internal mental models of attachment may be mediated by continuing openness of the brain to change in response to experience.
- Thus, the possibility remains that ongoing experiences, especially those involving the basic aspects of secure attachments described earlier, may enable some individuals to acquire a more richly developed capacity for neural integration.
- These basic relationship components include collaborative communication, reflective dialogue, interactive repair, coherent narrativization, and emotional communication.
- The hope is that interpersonal experiences that involve these basic components will offer respect for the individual’s subjective experience within emotionally engaging relationships.
- Relationships such as those of family, friends, psychotherapy, and the collaborative environment of nurturing communities might facilitate the development of flexible self-regulation and a more integrated way of life for all ages.
- If we can find a way to facilitate neural integration within the minds of individuals across the lifespan, we may be able to promote a more compassionate world of human connections.