Wired to Connect: Neuroscience, Relationships, and Therapy

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INTRODUCTION

As family therapists, we are accustomed to considering the multisystemic contexts of our clients' lives. Although we have extended our gaze to the macro systems in which families function, we do not generally have the knowledge to grasp the microsystemic level of our clients' internal experience in terms of brain processes. In the last decade, due in part to advanced neuroimaging techniques such as the fMRI, neuroscientists' understanding of the human brain has grown dramatically. The body of research data, which can be highly technical for nonspecialists, is becoming widely accessible thanks to several authors who integrate and present it in a compelling and even inviting manner. It is impossible to cover the vast and rapidly evolving field of neuroscience here. In this article, I will focus on what Daniel Siegel (1999) calls "interpersonal neurobiology," highlighting relationships, emotion, and the brain. As I read this literature, I find a tremendous overlap between our systemic perspective and the picture of the human being that is emerging from neuroscience. Understanding the key ideas from this developing field can enhance our own work, both theoretically and clinically. I will explore as well some clinical interventions that may be useful in integrating interpersonal neurobiology into our work as family and couple therapists.

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In this article, I draw extensively from several sources. These include therapists who integrate neuroscience, such as Daniel Siegel (1999, 2003, 2007; Siegel & Hartzell, 2003), Alan Schore (2003), Louis Cozolino (2002, 2006), and Brent Atkinson (2005). Some of this literature comes from neuroscientists themselves: Antonio Damasio (1994), Joseph LeDoux (1996, 2002), and Jaak Panksepp (1998). Finally, Daniel Goleman, a psychologist/science writer (1995, 2006), has illuminated neurobiology findings for a general audience. These authors, building on the vast research literature in neuroscience, share the perspective that relationships are crucial to brain development and neural functioning throughout the life cycle. As Siegel (2003) puts it, "The brain becomes literally constructed by interactions with others. . . . Our neural machinery . . . is, by evolution, designed to be altered by relationship experiences" (p. 18). Interpersonal neurobiology identifies how the brain is wired through relationships and connection.

WIRING AND NEUROPLASTICITY OF THE BRAIN

The human brain has billions of neurons, each with up to thousands of connections with other neurons. The neurons meet at synapses, small gaps between neurons, and communicate across the synaptic gap via neurotransmitters. There are trillions of neuronal connections in the human brain; it is considered the most complex entity in the universe. These connections form neural circuits, and the activation of these circuits in different parts of the brain gives rise to thought, emotion, and action.

Neuronal circuits are wired through a combination of nature and nurture, genetics and experience. The kind of parenting we receive as children, the nature of our relationships throughout life, and the experience of therapy all change the brain by changing synaptic connections and circuits. "Human connections create neuronal connections" (Siegel, 1999, p. 85). Because of the impact that social relationships have on our brains, Siegel has suggested that "the brain [is] the social organ of the body" (Siegel & Hartzell, 2003, p. 97). It is clear from neuroscience that nature and nurture are mutually recursive. "Experience shapes the brain throughout life by altering the connections among neurons. . . . Experience *is* biology" (Siegel & Hartzell, pp. 33–34). These observations are not mere metaphors; they are based on extensive and compelling research on the human brain, development, and relationships. Beyond affecting synaptic connections, experience—especially early parent-child experience—can modify the actual activity of genes (Begley, 2007).

The structure and wiring of our brains require the attunement and attentiveness of others. As Cozolino (2006) puts it, "The brain is an organ of adaptation that builds its structures through interactions with others. . . . There are no single brains " (p. 6). "The individual neuron or single human brain does not exist in nature. Without mutually stimulating interactions, people and neurons wither and die" (p. 11). Indeed, the failure to thrive and deaths of babies left unattended and unattached in orphanages, so poignantly described by infant specialists, bears out the literal truth of this statement. The profoundly relational nature of the person and of development described by interpersonal neurobiology echoes the relational view of many theorists in our field (Fishbane, 2001).

Therapists regularly struggle with the tension between change and stability in working with clients. A large literature in family therapy is devoted to the paradoxes of change, and ways to overcome clients' resistance. Neuroscience gives us insight into this dynamic so central to therapy. On the one hand, our actual brain structure—the neuronal connections and networks that determine our preferences, personalities, and survival strategies—is wired early and becomes hard to change. The frequently cited mechanism for this is Hebb's law: ''Neurons that fire together wire together'' (Siegel, 1999, p. 26); that is, the neurochemical linking of two neurons makes it more likely that they will be linked in the future. Scientists have located the biochemical process by which this wiring occurs; it is responsible for our habits and can be resistant to change at the synaptic level. On the other hand, change is possible; neurogenesis and neuroplasticity—the creation of new neurons and new neuronal connections—continue throughout our life spans. Experience alters the brain, even as we age. Whenever we learn something new, including new attitudes, perspectives, or behaviors, we are changing the physical structure of the brain. The phenomenon of neuroplasticity has been considered in depth by Begley (2007), a science writer who documented a historic meeting on this topic in 2004 between neuroscientists and the Dalai Lama. Brain changes in adulthood are thought to account for wisdom, which tends to develop in later life (Cohen, 2005).

THE EVOLUTIONARY CONTEXT

Neuroscientists consider the evolutionary development of the human brain. Much of our neural circuitry is similar to that of other mammals, especially primates; we share 98% of our DNA with chimpanzees (Fisher, 2004). The human brain is roughly organized in three interconnected layers, with increasing levels of complexity. The brain stem, the most basic brain area, regulates breathing, heart rate, and general alertness. The limbic system, developed in mammals, includes the amygdala, anterior cingulate, and hippocampus; much of our emotional processing occurs in the limbic area. The neocortex, especially the prefrontal cortex, is most developed in humans and is responsible for higher thought and executive functioning. The interconnections among brain stem, limbic, and neocortical areas are numerous and often bidirectional, with emotion, thought, and body processes all affecting each other.

We share with all animals the instinct for self-preservation. ''The fundamental behavioral tendency of all organisms is to approach what is life sustaining and avoid that which is dangerous'' (Cozolino, 2006, p. 28). The amygdala, ''fear central'' (LeDoux, 1996, cited in Goleman, 2006, p. 78), is particularly alert to danger and sends alarms throughout the body in threat situations. Like other animals, we are wired to respond instantly to threat: ''Human defensive behavior clearly seems to have a long evolutionary history'' (LeDoux, 1996, p. 130). This instinctive survival process often leads to grief in human relationships. When we feel threatened interpersonally, the amygdala leads us to fight or flee. The paradox underlying much of the push-pull ambivalence in human relationships is that we are wired both for self-protection and for connection (Atkinson, 2005).

The evolutionary importance of connection for human survival is emphasized throughout the neuroscience literature. ''Our social brains have been shaped by natural selection because being social enhances survival'' (Cozolino, 2006, p. 12). It has been noted that the size of the neocortex has grown in primates in proportion to the growth of the size of social groups. Much of the elaborate circuitry of the human brain is devoted to reading and decoding social cues. ''Given our dependence on groups for our very survival, primates have evolved elaborate neural networks for interacting with others as well as reading their minds and predicting their intentions. . . . These systems of attaching, predicting, and communicating are all functions of the social brain'' (Cozolino, p. 21).

Social connections facilitate survival in primates. Sociable baboon mothers who spend the most time grooming and socializing with other females are more relaxed, are better mothers, and have infants most likely to survive (Goleman, 2006). Taylor (2002) has identified the ''tend and befriend'' response in female primates and humans in response to threat, a counterbalance to fight or flight. Studies of humans of both genders point to the positive impact of nurturing relationships on physical and emotional health (Goleman, 2006). Conversely, social rejection in humans activates the same part of the brain as does physical pain, prompting speculation that ''exclusion could be a death sentence'' in human prehistory, so important was the group for survival (Goleman, 2006, p. 113).

THE EMOTIONAL BRAIN: A TALE OF TWO ROADS

Human emotions are not located in a single brain site; rather, they involve interconnected brain circuits. Most of our emotional life is processed nonconsciously and subcortically. We are often unaware that we are even having an emotion until after the fact, when our higher cortical processes kick into gear and consider the information from the limbic system and the rest of the body.

Neuroscientists differentiate between emotions and feelings. Emotions are considered evolutionary adaptations, nonconscious, and embodied. As LeDoux (1996) vividly notes, ''Our emotions are full of blood, sweat, and tears'' (p. 42). Panksepp (1998) identifies seven different emotional operating systems with different neural pathways and different evolutionary purposes: fear, care, lust, panic, seeking, play, and rage. Other authors note several universal human emotions, conveyed in facial expressions recognized across cultures: disgust, fear, happiness, sadness, and anger (Damasio, 1994). Feelings are our conscious awareness of emotions (Damasio); ''the body's response lets us know how we feel'' (Siegel, 1999, p. 146). Most of the action emotionally happens subconsciously; we may be driven by our emotions but unable to name our feelings. The neurological condition of alexithymia, the inability to identify or articulate one's feelings, is the extreme version of this phenomenon.

The extent to which our automatic emotional processes benefit or harm us is considered in the neuroscience literature. Joseph LeDoux (1996) has labeled the quick, nonconscious, reactive system the ''low road,'' and the more considered, thoughtful system the ''high road.'' We are equipped by evolution for both; the low, limbic road allows us instinctively to assess danger and protect ourselves, whereas the high, neocortical road gives us more flexibility, thoughtfulness, and choice. The classic example, originating with LeDoux and described by Goleman (1995), is of a person encountering what looks like a snake in the forest. The information about the object enters the human brain through the optic nerve, which sends signals to the thalamus; one route from the thalamus goes directly to the amygdala, which assesses the object for danger and typically leads to a fight-or-flight response. The person in our vignette is wise to flee quickly from the putative snake. At the same time, but traveling more slowly because of the more complex synaptic journey, the signals go to the visual cortex and higher thinking processes; the person may consider, is this a snake, or a stick? From a survival point of view, the quick, low-road amygdala response can be lifesaving. As LeDoux puts it, ''It is better to have treated a stick as a snake than not to have responded to a possible snake'' (p. 166). The price we pay for our evolutionary protection is overreactivity in our human relationships. When we feel threatened, now not by a snake but by our spouse, the low road of the amygdala kicks into gear, and we may respond irrationally and with intense emotion.

The high-road and low-road language at times sounds disparaging of our automatic, nonconscious responses. But our ability to assess and respond quickly—the work of our ''adaptive unconscious'' (Gladwell, 2005)—is vital to our survival and social functioning. Although the amygdala can get us into social trouble, it is also a key component in social attunement. People with damaged amygdalas are impaired in empathy and in the capacity to judge the trustworthiness of others (Goleman, 2006). This limbic structure gives color to our emotional lives and, if paired with a functioning prefrontal cortex, helps guide our decision-making. The amygdala, along with other information from our bodies (e.g., the vagus nerve, which sends up ''gut feelings'' from the stomach to the brain, and the insula, which reads body states), helps us stay in tune with ourselves and others at a nonverbal level. Our emotional brain constantly appraises faces and other stimuli for positive or negative valence, for safety or danger. Damasio (1994) emphasizes the crucial role of emotion in informing reason as we navigate through our social lives.

The neocortex, or ''high road,'' allows us to pause and consider our options, to think before we react impulsively. The integration of prefrontal cortex with limbic system is necessary for emotional and relational well-being. When we encourage clients to observe their own reactivity, meditate, or take a time-out from a fight, we are helping them engage their higher brain functions, especially their ventromedial (middle) prefrontal cortex. Part of this section, the orbitofrontal cortex (OFC), one synapse away from the limbic system, brain stem, and neocortex, serves as the brain's emotion regulation system and ''chief executive officer'' (Siegel & Hartzell, 2003) of the social/emotional brain. It functions at the interface of higher and lower brain regions, integrating neocortical and limbic functions. The OFC calms down the amygdala and helps us make choices in keeping with our goals and values; it allows us to choose the high road. The OFC is active in processes of self-awareness, response flexibility, regulation of emotion, and empathy or ''mindsight'' (Siegel & Hartzell). The OFC continues to develop throughout the life span; it is characterized by neuroplasticity, or the ability to change at the neural level.

There are limits, however, to the orbitofrontal cortex's ability to keep the amygdala in check. Early trauma, abuse, or neglect can impair the OFC's functioning. Furthermore, the amygdala can overwhelm even a healthy prefrontal cortex: ''The connections from the cortical areas to the amygdala are far weaker than the connections from the amygdala to the cortex. This may explain why it is so easy for emotional information to invade our conscious thoughts, but so hard for us to gain conscious control over our emotions'' (LeDoux, 1996, p. 265). A damaged OFC results in impairment in judgment, self-control, and emotional fluency. On the other hand, an overactive OFC, stuck in the ''on'' mode, has been implicated in obsessive-compulsive disorder (Schwartz & Begley, 2002).

Much interpersonal communication happens nonverbally, nonconsciously, right brain to right brain; as Goleman (2006) puts it, we communicate across the social synapse, at times not even aware that we are doing so. Sometimes this can be soothing, as when in the presence of an attuned therapist, parent, or partner. At other times, it can be dysregulating. Emotions tend to be ''contagious'' (Goleman, p. 13), and we can take on the agitation of another without knowing why or how we got there. ''Like secondhand smoke, the leakage of emotions can make a bystander an innocent casualty of someone else's toxic state'' (p.14). Whether we benefit or are harmed by a particular interaction,

> we are wired to connect. Neuroscience has discovered that our brain's very design makes it sociable, inexorably drawn into an intimate brain-to-brain linkup whenever we engage with another person. That neural bridge lets us affect the brain—and the body—of everyone we interact with just as they do us. (p. 4)

Young children are particularly vulnerable in this regard. The infant's amygdala is functioning at birth and comes to full maturity early on. Emotion processing occurs mostly in the right hemisphere, which is dominant in its growth during the first 3 years of life. The left hemisphere, responsible for linear, logical thinking and for verbal production, develops later. The baby's right brain is wired in concert with the parent's or caregiver's right brain through nonverbal interaction (Schore, 2003). During the exuberant growth period of the infant's right brain in the early years, there is a special sensitivity to the interpersonal environment that helps shape the child's emotional brain.

TRAUMA AND THE BRAIN

When human connections go awry, especially early in life, brain circuitry can be impacted. Chronic misattunement, neglect, or abuse on the parent's part can severely affect the baby's brain, impairing the corpus callosum, the main connecting pathway between right and left hemispheres (Siegel, 2003); the hippocampus, central to memory function (Sapolsky, 2004); neural integration (Siegel, 2003); overall brain size; and growth of GABA fibers that calm limbic structures (Siegel & Hartzell, 2003).

With trauma and its accompanying high level of cortisol release, the amygdala overfunctions, holding emotional traumatic memories, whereas the OFC underfunctions. We are wired to respond to threat with a readiness for action or flight; the amygdala sends alarms throughout the body, stress hormones are released, and muscles are tensed for action. With traumatic experiences in which the person is blocked from fight or flight, as in sexual abuse, the brain and the body are unable to do their work in response to threat (van der Kolk, 2006). Posttraumatic stress disorder (PTSD) is considered a physical reliving of the trauma, with all the attendant hormonal activation. In flashbacks, the amygdala is overactive, and the prefrontal cortex is temporarily disabled. Bessel van der Kolk (2001), a major writer in the trauma field, notes that individuals with PTSD ''are very sensitively tuned to pick up threat and respond to minor stimuli as if their life were in danger.''

Neuroscientists have identified two different types of memory: explicit and implicit. The hippocampus, the seat of explicit memory, is not developed until 18 months. However, the implicit memory system, involving limbic processes, is available from birth. Many of our emotional memories are laid down before we have words or explicit recall, yet they influence our lives without our awareness. Although a traumatized person may not explicitly remember the traumatic event(s), the memory is held in the body: ''What the mind forgets, the body remembers in the form of fear, pain, or physical illness'' (Cozolino, 2006, p. 131; Van der Kolk, 1994). A woman may not remember that she was sexually abused repeatedly by her father as a girl but may panic when her husband approaches her for sex. These emotional memories may never be erased: ''Unconscious fear memories established through the amygdala appear to be indelibly burned into the brain. They are probably with us for life'' (LeDoux, 1996, p. 252). LeDoux, the neuroscientist who has been a major contributor to our understanding of fear and the role of the amygdala, observes that

> perhaps trauma, . . . in some persons, biases the brain in such a way that the thalamic pathways to the amygdala predominate over the cortical ones. . . . Later exposure to stimuli that even remotely resemble those occurring during the trauma would then pass, like greased lightning, over the potentiated pathways to the amygdala, unleashing the fear reaction. (pp. 257–258)

ATTACHMENT: THE TIES THAT BIND

The fields of neuroscience and attachment converge in the work of Siegel and Schore, among others. The healthy development of the child's right brain—especially the limbic system and orbitofrontal cortex, which are involved in emotional functioning and affect regulation—depends on a secure early environment with caregivers. Attachment researchers, building on Bowlby's attachment theory, identify secure attachment as the child seeking proximity to the parent, the parent offering a safe haven in times of distress, and the parent-child bond offering a secure base from which the child can explore the world (Siegel & Hartzell, 2003). Insecure attachments can take the form of anxious, avoidant, or disorganized patterns.

Research has identified the intricate dance between parents and baby that facilitates the baby's brain development. Part of the mechanism is the eye gaze: ''Seeking proximity to a caregiver and attaining face-to-face communication with eye gaze contact is hardwired into the brain from birth. It is not learned'' (Siegel, 1999, p. 138). This contact is deeply pleasurable: ''In mutual gaze the mother's face is triggering high levels of endogenous opiates in the child's growing brain'' (Schore, 2003, p. 14). The infant is an active participant in this dance:

> Virtually from birth, babies are not mere passive lumps but active communicators seeking their own intensely urgent goals. . . . Babies need to be tiny masters at managing their caretakers through an elaborate, built-in system of eye contact, smiles and cries. . . . The emotions of the infant direct what the mother does as much as the mother directs the infant. . . . Their loop operates in both directions, a primal emotional highway. (Goleman, 2006, pp. 163–164)

This ''lyrical duet'' (Cozolino, 2006, p. 97) between infant and parent shapes and changes the brains of both. Not only are the bonding and pleasure chemicals of oxytocin and endorphins released in this process, but the infant's brain structure is changing as well:

> Early in life, infants need connections to caregivers in order to organize their brain's function in the moment, and to allow it to develop properly over time. This is called ''dyadic

> regulation''. . . . Interactions with caregivers allow the child's brain to develop the neural structures necessary to move from dyadic regulation to more autonomous forms of self-regulation. (Siegel & Hartzell, 2003, p. 215)

Our need for secure attachments and our vulnerability to the ups and downs of our relational lives continue throughout adulthood. Whereas distressed adult relationships are correlated with increased secretion of stress hormones and lowered immune functioning, nurturing relationships are correlated with better physical health, including heart and immune function, and resistance to stress (Cozolino, 2006). As Lewis, Amini, and Lannon (2000) put it, ''Stability means finding people who regulate you well and staying near them'' (p. 86). Healthy interdependence in adulthood entails a balance between self-regulation and looking to others for resonance and soothing in intimate relationships.

Most studies of attachment look at the mother-infant pair bond. As systemic therapists, we look as well at the father-infant bond, the nuclear family system, and the larger context, considering the couple's relationship and the family's network of support and resources. What happens to a securely attached parent and child, or a securely attached couple, if they experience overwhelming trauma, poverty, racism, or other contextual stresses? A breakdown in the contextual support system or other stressors could override a parent's or spouse's ability to attune to and bond with the child or partner. Indeed, a study was done with well-attached baby monkeys and their mothers, who were subjected to an uncertain supply of food. The mother monkeys, normally attuned to and facilitative of an attachment bond in their offspring, became preoccupied and anxious. Their offspring turned into adult monkeys with difficulty in social behavior and in bonding with a mate. These offspring could not self-regulate when they were not in the physical presence of their mothers (Lewis et al., 2000). In addition to considering the attachment style of the individual, it is important to consider the larger context in which our clients are embedded. We need to take into account the potentially detrimental impact of poverty and violence on the growing brains of young children. And yet poor families do not necessarily lead to damaged attachment systems; through extended family kinship networks, ''alloparents'' (Hrdy, 1999), and faith-based support, many families are resilient despite the odds.

ATTUNEMENT: ''FEELING FELT''

Secure attachment is built on the attunement of the parent with the infant. Attunement entails both low- and high-road circuits; ''primal empathy,'' including nonverbal synchrony, is a subcortical, emotional resonance between individuals; and ''empathic accuracy'' requires activation of the prefrontal cortex as thought and feeling are joined in understanding the other (Goleman, 2006). Siegel emphasizes contingent communication in healthy parent-child relationships, in which parents modulate and attune their responses to the child's needs. With parental empathy, the child ''feels felt'' (Siegel & Hartzell, 2003) and develops a confidence in his or her experience. Self-esteem and self-confidence are built on this interpersonal dance of attunement and empathy.

Among the neural components of empathy are mirror neurons. These neurons were first discovered in the early 1990s in monkeys. An experimenter returning from lunch was licking an ice cream cone as he came into the lab to resume studies of a monkey's brain, which was wired for the test. The experimenter was astonished to find that the part of the monkey's brain that would fire if the monkey itself was eating, fired when watching the experimenter eat his ice cream (Goleman, 2006). The mirror neuron system in humans is more complex and allows us to feel what another is doing or feeling as if we were doing or feeling it ourselves: ''This system of mirror neurons may be the early basis for how one mind creates the mental state of another inside itself'' (Siegel & Hartzell, 2003, p. 65). This ability ''to know another from the inside out'' (Cozolino, 2006, p. 202) accounts for the immediate, visceral sense of resonance that we experience in moments of connection and empathy.

''Feeling felt'' is important in adult relationships as well as in parent-child interactions. Empathy soothes us and makes us feel safe. ''An act of empathy is a masterly tension reducer'' (Goleman, 1995, p. 143). We tune in to each other beneath awareness: ''When two people feel rapport, . . . their very physiology attunes'' (Goleman, 2006, p. 28). As in infant-parent attunement, lovers attune through the eye gaze. ''Locking eyes loops us. To reduce a romantic moment to an aspect of its neurology, when two people's eyes meet, they have interlinked their orbitofrontal areas, which are especially sensitive to face-to-face cues like eye contact'' (Goleman, 2006, pp. 63–64).

Simon Baron-Cohen (2003), in his research on autism, developed the Reading the Mind Through the Eyes test, in which the subject is to read the emotion on another's face only by looking at the eyes. Autistics score poorly on this test and tend to have damage in the mirror neuron system for reading facial expressions (Goleman, 2006); although able to describe a social interaction, they may not be able to feel it from the inside out.

The downside of empathy and resonance is that we can drive each other into states of dysregulation quickly, and beneath awareness. Through mirror neuron and other neurophysiological systems, we feel with others, for good or for bad. The ''limbic tango'' (Goleman, 1995, p. 141) of many heterosexual couples in conflict has been studied by Gottman (1999): When a wife raises conflictual issues, the husband's heart rate may escalate, flooding him physiologically; he then shuts down or stonewalls, leaving the wife with the highly distressed heart rate. Similarly, emotionally dysregulated parents communicate their distress to their children even if there is no explicit discussion, and even if parents deny that they are upset.

To feel empathic with another—to have ''mindsight'' (Siegel, 1999)—one must be calm and receptive (Goleman, 1995); empathy does not coexist with agitation or preoccupation. Mindsight is facilitated in children when parents have ''reflective conversations'' (Siegel & Hartzell, 2003, p. 223) with their youngsters about each person's experience. Siegel sees us as hardwired for mindsight potential but emphasizes that the capacity is nurtured and shaped through experience.

Empathy is not a steady state; even in healthy relationships, breaks or ruptures in attunement are inevitable. Siegel differentiates between these normative disconnections and ''toxic ruptures'' (Siegel & Hartzell, 2003, p. 193), as when a parent has entered the low road of rage or reactivity, and the relationship may become traumatic and damaging to the young child. Siegel highlights the importance of repair following disconnections or ruptures; without repair, the child is left with a sense of humiliation (Schore, 2003) and a discomfirmation of his or her experience and self-worth. Siegel and Hartzell note that it is difficult while on the low road of rage to recover immediately and resume the high road; they recommend that parents wait until they calm down before having a repair conversation with their child. Similarly, in working with couples caught up in reactivity and elevated heart rates, Gottman and Gottman (2005) recommend a Take a Break ritual of at least 20 minutes, resuming the conversation when both are calmer. Gottman (1999) also emphasizes the role of repair in couples' relationships—either explicit repair attempts such as apology and forgiveness, or subtler repair such as touch or humor.

In his latest book, focusing on mindfulness meditation, Siegel (2007) proposes that mindfulness, a kind of ''intrapersonal attunement'' (p. 16), uses the same ''resonance circuitry'' (p. 165) as empathy with others, ''harness[ing] the social circuits of the brain'' (p. 347). He suggests that ''in mindful awareness we can transition from being reactive to becoming receptive'' (p. 127); this intrapersonal openness would presumably promote interpersonal receptivity as well. In Siegel's view, mindful awareness both builds ''vertical integration'' (p. 298) between mind and body and promotes a ''consciousness [that] permits choice and change'' (p. 298).

RELATIONAL POWER: CULTIVATING EMOTIONAL INTELLIGENCE

Feminist writers such as Goodrich (1991) and Surrey (1991) have widened our constructions of power, discussing ''power to'' as well as ''power over.'' I would suggest that ''power to'' includes social and emotional intelligence, the ability to navigate intelligently within a relational context. Emotional intelligence, according to Goleman (1995), includes the capacity to self-regulate, delay gratification, empathize, be self-aware, and motivate oneself. In extending his focus to social intelligence, Goleman (2006) considers both social awareness (primal empathy, attunement, empathic accuracy, social cognition) and social facility (nonverbal synchrony, self-presentation, influence, concern for others).

The capacity to self-soothe when agitated emerges as one of the key ingredients for emotional and relational well-being in the neuroscience literature. In his earlier book, Goleman (1995) vividly described the ''highjacking'' of the brain by the amygdala, shutting down the higher brain. Siegel (1999) identifies ''response flexibility'' (p. 140) as central to emotional health; in the face of stress and discomfort, the individual with response flexibility is able to stay calm, or at least recover from an agitated state quickly. This is the high road, powered by the prefrontal cortex. It counters the impulsiveness and reactivity of the low road (Siegel & Hartzell, 2003). As Davidson (2004) notes, ''The capacity for rapid recovery following negative events may define an important ingredient of resilience'' (p. 1397). According to Davidson, persons with anxiety and mood disorder often have difficulty with this recovery. Davidson has found that people with ''a resilient affective style'' tend to have ''high levels of left prefrontal activation'' (p. 1395) and lower levels of basal cortisol (a stress hormone). Reciprocally, high levels of right prefrontal activation are associated with a predominance of negative affect. Goleman (2006, p. 181) discusses Davidson's finding that people have different emotional set points, ''dour or upbeat,'' related to their prefrontal activation profile. That our amygdalas will get activated and that we will wind up on the low road at times is a human given. How we learn to manage the low road may determine our emotional resilience. Research indicates that mindfulness meditation increases left prefrontal activation (Siegel, 2007), along with increased well-being and improved immune functioning.

NEUROSCIENCE AND COUPLE RELATIONSHIPS

The neurobiology of love in adult relationships has also received attention in this literature. For better or worse, intimate partners affect each other's well-being, both emotionally and physically. As Goleman (2006) puts it, the ''fluidity of boundaries between people who feel close allows a two-way coregulation, influencing each other's biology. In short, we help (or harm) each other not just emotionally but *at a biological level*. Your hostility bumps up my blood pressure; your nurturing love lowers it'' (p. 246).

Research has found that sick and elderly patients do better medically if they have a strong network of supportive relationships; Goleman (2006) refers to these nurturing supports as ''biological allies'' (p. 246). He notes, ''Resonant relationships are like emotional vitamins, sustaining us through tough times and nourishing us daily'' (p. 312).

> Conversely, data from a number of large epidemiological studies suggest that toxic relationships are as major a risk factor for disease and death as are smoking, high blood pressure, or cholesterol, obesity, and physical inactivity. Relationships cut two ways: they can either buffer us from illness or intensify the ravages of aging and disease. (Goleman, 2006, p. 224)

Some evidence suggests that marriage tends to have a positive effect on men's health; for women, it depends on whether the marriage is satisfying. Women are more vulnerable to a stressful marriage than are their husbands; a woman's stress hormones increase when her husband withdraws in anger and decrease when he is kind and empathic (Goleman, 2006; Taylor, 2002). Some authors explain this difference on the basis of women being more invested in and attuned to their intimate relationships. Men are also vulnerable to marital stress; according to Gottman (1999), many men get flooded, with accelerated heart rate, in the face of conflict. Gottman links this phenomenon to men's tendency to stonewall, a survival mechanism to shut off the potentially toxic stress produced by flooding.

Despite the difficulties in couple relationships, humans do seem to be wired for love as well as connection; we have a tendency to form ''pair bonds,'' as do many of our relatives in the animal kingdom. Helen Fisher (2004), an anthropologist, has explored this topic extensively. In a study of people who were ''crazy in love,'' she observed their brain function in the fMRI machine as they looked at photos of their beloved. The part of the brain that was most activated is the same region affected by the use of addictive drugs such as cocaine: the caudate nucleus, part of the brain's pleasure and reward system. Fisher posits that ''romantic love is an addictive drug'' (p. 182). She goes on to spell out the shared physiological and psychological phenomena of these addictions, including the anguish of withdrawal when the drug or the lover is absent.

Fisher (2004) proposes three different brain circuits for love, each with its own hormones and, in her description, evolutionary purpose. The first, which she calls lust, is fired by testosterone in both males and females and leads to sexual unions with various partners. The second, romantic love, is fired by dopamine and norepinephrine; its evolutionary goal, according to Fisher, is to focus courtship on a single mate. It lasts approximately 12–18 months. Finally, attachment, fired by the ''cuddle chemicals'' oxytocin and vasopressin (p. 89), serves, according to Fisher, to keep these mates together to rear their offspring together. Fisher's evolutionary system does not address such issues as homosexual or childless unions and how the attachment system works under those circumstances.

Oxytocin is most active in females; it is released with orgasm, birth, nursing, nurturing touch, and warm conversations (Carter, 2006). Males experience the release of oxytocin and its bonding effects; they are highly affected as well by vasopressin, a hormone related to oxytocin, released with ejaculation. In humans, oxytocin has many beneficial health effects. It reduces cortisol and other stress hormones (Carter). Pairing, attachment, and feeling safe all release oxytocin and are strengthened by it. By contrast, fear and chronic stress reduce oxytocin levels. Oxytocin helps bond mother and infant and is an active hormone in the nursing process. It lowers blood pressure, increasing a sense of peace and relaxation. Oxytocin is released ''whenever we engage in affectionate contact with someone we care for'' (Goleman, 2006, p. 216).

The chemicals of love can contradict and undermine each other. Oxytocin and vasopressin can lower testosterone levels, and vice-versa. ''The chemistry of attachment can dampen lust'' (Fisher, 2004, p. 91). Likewise, lust does not necessarily stimulate romance or attachment. As Fisher says poignantly, ''Alas, many of us . . . have periods in our lives where these three mating drives—lust, romantic love, and attachment—do not focus on the same person'' (pp. 93–94).

APPLICATIONS TO THERAPY

One of the messages for therapists from interpersonal neurobiology is the importance of addressing our clients' emotional lives. In addition to facilitating new narratives and behavioral changes, ''limbic revision'' (Lewis et al., 2000, p. 144) is called for, a transformation within the emotional brain. This process requires trustworthiness and attunement on the part of the therapist. For the client to ''feel felt,'' the therapist must be present emotionally and able to resonate empathically with the client, integrating high road with low, thoughts with emotions.

Siegel (2003) notes that good therapy entails ''attunement of right-to-right hemisphere'' between therapist and client (p. 32). This nonverbal limbic connection may evoke an uncomfortable emotional resonance in the therapist, who needs to be centered and able to identify and manage his or her own reactivity. When there are therapeutic breaks in empathy, as will happen even to the most accomplished therapist, repair—including acknowledgment and apology—is necessary. The shift in family therapy to a nonshaming, nonpathologizing stance on the part of the therapist is crucial for clients to risk exploring their inner emotional lives.

A therapy that builds on interpersonal neurobiology facilitates emotional intelligence and relational empowerment in clients. Atkinson (2005) refers to therapists as coaches, ''teachers of emotional literacy'' (p. 65). Working with a wine connoisseur, he encouraged his client ''to become a connoisseur of his internal experience'' (p. 58), learning to read his own brain states and body cues. The tone is one of acceptance and curiosity about one's own experience, rather than a repressive attempt to control one's reactivity.

Discussing foundational insights from neuroscience can facilitate transparency in the therapy and a collaborative, nonhierarchical relationship between therapist and client. I find it helpful to share with my clients some of the ''news'' from interpersonal neurobiology. For example, I normalize reactivity, such as defensiveness or counterattack, as a hardwired, natural response to feeling criticized or attacked. Clients are intrigued to learn where in their brains their reactive responses originate, and how —and through what brain mechanisms—they can gain the high road when on the low road. Identifying problematic reactions with specific brain states tends to depathologize clients' behaviors, opening them to more interest in changing themselves: ''Knowing about the brain can allow someone to move from self-judgment to self-acceptance'' (Siegel & Hartzell, 2003, p. 169).

I encourage clients to image their own reactive, angry part (amygdala), and their calm, integrative, self-regulating, self-soothing part (OFC) in dialogue with each other. Clients love this imagery work and feel empowered to make a difference in their own reactivity. Similar to Internal Family Systems (IFS) parts work (Schwartz, 1995), this imagery helps them identify their reactive part without shame, seeing the amygdala as reactive rather than the whole self as out of control. Although the amygdala can ''highjack the brain'' (Goleman, 1995), clients can also see their prefrontal cortex step in like a good, loving, firm parent and help the amygdala settle down. If the client is an empathic parent to his or her own (actual) child, I borrow from that capacity and encourage the client to parent himself or herself more compassionately. As Siegel and Hartzell (2003) put it, ''You can give to yourself the tools that your parents were not able to offer you as a child. In many ways, this is parenting yourself from the inside out'' (p. 138).

Neuroscience can be helpful psychoeducationally, especially around a current reaction fueled by old issues. The amygdala ''is quick to learn and slow to forget. Learned fears are tenacious and tend to return when we are under stress'' (Cozolino, 2006, p. 318). These old fears take hold of us without our even knowing that it is happening. When we are in a situation that feels similar to painful experiences in the past, we may become gripped by fear or anxiety, without making any conscious connection to our original learned fear. Couple therapists routinely see partners get reactive with each other over seemingly small slights or wrongs; the here-and-now interaction often doesn't make sense until we explore the overlap of current experience with traumas or wounds from the past (Scheinkman & Fishbane, 2004). Likewise, parents may become enraged with their young children's boisterous behavior if it reactivates past experience in the parents' families of origin or other traumatic events (Siegel & Hartzell, 2003).

Self-observation and self-empathy can change one's reactivity: ''Even just naming for ourselves the emotions we feel can calm the amygdala'' (Goleman, 2006, p. 77). Observing our emotions activates the prefrontal cortex. Just as observing any behavior can change that behavior, as in keeping food or smoking records, the act of awareness increases one's potential for flexibility and choice. However, observing and naming one's own emotions may be difficult for clients who did not grow up in attuned environments that facilitated empathy—true of many men, socialized to equate strength with toughness and weakness with emotional expression, and of members of both sexes whose parents were not emotionally attuned. In such situations, I start by having clients observe and name their body sensations, which are the first signs of an emotion; this training in self-empathy is a central tool for emotional intelligence. For example, a person with a temper may be able to identify prodromal body cues that precede a blowup and learn to back up and tune in to these precursors to a meltdown before it occurs.

Other techniques that facilitate somatic attunement are helpful in this work, such as breathing, meditating, and other body focusing techniques. This is particularly helpful for clients who are highly verbal and left-brain oriented or who are out of touch with their body and emotions (Siegel & Hartzell, 2003). Atkinson (2005) encourages clients to do ''daily awareness work'' of their own brain states, offering this as akin to ''a spiritual practice'' (p. 56). Research about the beneficial impact of meditation on mood and resilience (Begley, 2007; Davidson, 2004; Siegel, 2007) underscores the power of these mind/body practices.

Helping clients learn to self-soothe is crucial to emotional intelligence. There is a fine balance in a healthy relationship between being able to calm oneself and looking to one's partner for soothing; both are necessary. Couples often end up fighting when one looks for soothing from the other, who is either not in the mood or is unable to provide it. As clients learn to read their own emotions and calm themselves down, they are less at the mercy of their partner or other significant people in their life, such as parents or friends, when upset. This ability to self-regulate is an essential component of differentiation, in which one can feel calm in an emotional situation. It is not meant to replace interdependence or mutual soothing but to balance interdependence with emotional resilience. Johnson (1996) addresses this balance in her attachment-based approach to couple therapy.

When a couple in therapy is embroiled in a power struggle, using ''power over'' tactics with each other, I suggest that people attack or defend when they feel threatened and don't know what else to do. With the perspective of neuroscience, I point out that their amygdalas are running the show when they become reactive with each other, with each person's survival strategy triggering the other's (Scheinkman & Fishbane, 2004). I suggest that power struggles in an intimate relationship are a sign that partners are feeling *disempowered* relationally, not knowing how to get each other's attention, and so become reactive with each other. I then offer the couple ''tools for your toolbox,'' ways to get each other's attention more successfully. I help partners learn to ''make a relational claim'' (Fishbane, 2001), speaking one's own needs while holding the other's needs and concern for the relationship at the same time. Making a relational claim depends on such aspects of emotional/social intelligence as being able to read one's own and the other's emotions, balancing complex claims and needs, and inhibiting impulsive reactivity. This work is similar to Dan Wile's (2002) encouraging couples to have a voice in the relationship, to make the partner an ally rather than an enemy (through criticism) or a stranger (through avoidance or withdrawal). It also is parallel to Atkinson's (2005) encouraging clients ''to stand up for themselves without putting their partners down'' (p. 211).

Making a relational claim is more successful when a client has learned to identify the vulnerability that is triggering his or her survival strategy (Scheinkman & Fishbane, 2004). I encourage couples to diagram their dance in terms of vulnerabilities and knee-jerk survival strategies and to learn to catch themselves when stirred up before they attack, defend, or withdraw. Presenting one's vulnerability to the partner often invites empathy and nurturance from the partner, as does stating one's needs in a manner that includes the partner's perspective as well.

When identifying a client's relational disempowerment, as manifested in reactivity or defensiveness, it is important for the therapist not to shame the client but rather to normalize the use of survival strategies as part of our neurobiological, evolutionary legacy. At the same time, by offering strategies that are more successful relationally, the therapist helps the client make more thoughtful choices that involve cortical as well as limbic processes. Some clients only feel entitled to make their case or feel their feelings if they have worked up a head of steam and are very angry. Coming from a more vulnerable position may feel illegitimate or foreign if they were raised to feel unentitled to their own experience or if they were so parentified that they never learned to tune into their own feelings.

Couple therapy often entails facilitating empathy between the partners. Atkinson (2005) notes that maintaining concern and empathy for one's partner who is upset requires shifting from ''self-protective brain states to those mediating nurture and sorrow'' (p. 35). Rather than lecture clients about being less reactive or harsh with each other, the therapist helps partners get in touch with their own sadness or concern for each other. The therapist encourages clients to reach out to each other, expressing their ''protective urge'' (Fishbane, 2005) for each other, rather than defending the self through self-protective instincts.

Some clients haven't developed the skill of empathy; in such a situation, I might offer brief empathy training. While clients are trying to get the hang of empathy, they tend to work their way slowly through an interactional moment, talking themselves through it using their left brain: ''If I were my wife right now, what might I be feeling?'' This can feel maddeningly slow and wooden to the other partner, who may be impatient with the pace and awkwardness of the learner's process. If one partner is adept at empathy whereas the other is a new learner, the therapist needs to manage their differences, respecting each partner's experience. In most cases, eventually the learning partner gets the hang of empathy in a more intuitive, flowing way, with left and right hemispheres communicating better as the client manages this skill more naturally. Some clients distrust the slow pace and hard work, feeling that if something doesn't come naturally, ''from the heart,'' it isn't real. Using ''news from neuroscience,'' I reassure them that the rewiring through empathy training will eventually become ''natural'' but that it requires a lot of practice and a lot of awkward attempts before the new skill flows easily.

Therapy facilitates various levels of integration between: thought and feeling, cortex and limbic system, mind and body, conscious and unconscious, explicit and implicit memory, left and right hemispheres. It also entails building new narratives that facilitate these levels of integration, new stories that open possibilities and weave together the various aspects of clients' experiences (Cozolino, 2002; Siegel, 1999). Many neuroscience writers have noted that Freud's focus on the unconscious has been validated by discoveries about right-brain, limbic functioning, most of which occurs beneath awareness. Although authors who integrate neuroscience and therapy differ on their predilection for psychoanalytic or systemic approaches, the integration of conscious and unconscious is shared as a therapeutic goal. The unconscious discussed here is not a deeply repressed unconscious, but rather an experience beneath awareness; therapy facilitates conscious awareness of these limbic experiences, allowing for a narrative that includes thought and emotion to be joined.

As noted above, one of the dilemmas that therapists face is the tension between change and stability. Olga Silverstein emphasizes that we must respect our clients' need for stability in order to free them up for change (Keeney & Silverstein, 1986). Even as clients come to therapy seeking change, they fear letting go of the known or being forced into change. I have come to honor clients' no-change positions and don't get into power struggles over ''resistance.'' I view resistance as clients wisely clinging to survival strategies that may have literally saved their lives in the past. Understanding the tenacity of habit through Hebb's law allows me to work with clients more respectfully, accepting their desire to change as well as their ambivalence about change.

By the same token, neuroscience explains how change happens at all. In the context of new learning and life experience, new neuronal connections get made; Hebb's law explains the strengthened connections involved in such learning. Our clients are ''laying new neurological cable'' (Scheinkman & Fishbane, 2004, p. 296), creating new neural circuits. However, because change entails rewiring, for the connections to last, there needs to be much repetition and overlearning of the new behavior or experience. Some therapists use audiotapes for clients to practice at home what they are learning in therapy (Atkinson, 2005; Siegel, 2007). The soothing tone of the therapist's voice is probably as important as the words spoken. One couple I saw in therapy spontaneously named the salt shaker on their kitchen table after me; when they would become reactive, the salt shaker witnessed them and reminded them of our work in therapy. Although I do not aspire to become a fixture in my clients' homes, this kind of imagery can anchor the changes for some clients. I might suggest to clients that they choose a place in their home that, like the therapy office, is a place of honesty, trust, and respect, and that they go to that corner periodically between sessions. As in my office, shame and blame are invited to leave that space as the couple claim for themselves the safety of a mutually respectful context. Having such a nonverbal representation of the trust they are trying to build can help them relate in a more thoughtful, integrated manner with each other.

CONCLUSION: NEUROSCIENCE MEETS FAMILY THERAPY

Many of our best systemic practices and theories are strengthened by the field of interpersonal neurobiology, and some of our worst practices and fads over the years have been problematic in ways that make sense from a neuroscience perspective. Our basic beliefs about systems, contexts, and socially constructed meaning are validated by brain science; clearly, what is emerging is a relational view of the person and the vital importance of relationships for our survival and for the wiring of our brains. The use of narrative in therapy as a process of integrating thought and feeling is supported by interpersonal neurobiology, especially the work of Siegel. Differentiation—the integration of thought and feeling, the capacity to be calm in oneself while being present to others—emerges as central to social and emotional intelligence. Family therapists have promoted curiosity in our clients and in ourselves; this probably facilitates connections between the prefrontal cortex and the limbic system. Self-reflection in general—through guided imagery, IFS parts work, meditation, inner dialogue, journaling, or self-empathy—activates the same circuitry, helping clients respond thoughtfully rather than in a reactive manner driven by the amygdala.

I would suggest that we increase our focus on clients' emotional experience, given the clear importance of emotional life emerging from neuroscience. Developing more theory and techniques that address emotion would strengthen our practices, a trend that is growing in other kinds of therapy. Attending to limbic system functioning—emotions and other nonconscious experiences—is crucial both to understanding our clients and to facilitating lasting change.

Early in the developmental history of family therapy, in reaction to psychoanalysis, we focused on the family system rather than the individual. Over the years, we have reclaimed our interest in the individual. I would submit that this shift is crucial given what we know from interpersonal neurobiology. Indeed, a truly multisystemic perspective is biopsychosocial. Our future success as family therapists depends, I believe, on updating our theories and approaches based on an understanding of the human being at a truly multisystemic level. Interpersonal neurobiology adds a rich perspective that can contribute to this process.

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interesting on neuroscience and relationships. Copyright: Attribution Non-Commercial (BY-NC).Â A large literature in family therapy is devoted to the paradoxes of change, and ways to overcome clientsâ€™ resistance. Neuroscience gives us insight into. its structures through interactions with.Â we are wired to connect. Neuroscience has discovered that our brainâ€™s very design makes it sociable, inexorably drawn into an intimate brain-to-brain linkup whenever we engage with another person. That neural bridge lets us affect the brain F and the body F of everyone we interact with just as they do us. (p. 4). PDF | Cozolino, Louis.The Neuroscience of Human Relationships: Attachment and the DevelopingSocial Brain. Norton, 2006.Goleman, Daniel. Social | Find, read and cite all the research you need on ResearchGate.Â and Therapy. Mona dekoven fishbane,ph.D.w. Fam Proc 46:395â€“412, 2007. Cozolino, Louis. The Neuroscience of Human Relationships: Attachment and the Developing. Social Brain. Norton, 2006.Â particular interaction, we are wired to connect. Neuroscience has discovered that our brainâ€™s very design makes it. sociable, inexorably drawn into an intimate brain-to-brain linkup whenever we engage with.

wired to connect by Fishbane - Free download as PDF File (.pdf), Text File (.txt) or read online for free. interesting on neuroscience and relationships.Â literature in neuroscience, share the perspective that relationships are crucial to brain development and neural functioning throughout the life cycle. As Siegel (2003) puts it, Our neural. Wired to Connect: The Sur has been added to your Cart. Add gift options. Buy usedÂ Relationships and your brain form a virtuous circle, so by strengthening your neural pathways for connection, you will also make it easier to build the healthy relationships that are essential for your psychological and physical health. For many people, the news about the importance of relationships began with a 1998 study at the University of Parma in Italy, a study that proved how deeply connected we are to one another, right down to our neurons. Your Feelings, My Brain.Â As one client said, â€œRelational therapy differed from my previous therapy, which was about me as an individual with no real connection to the therapist. In relational therapy, we worked together. Neuroscience explains the connection between environment and behaviors; from perception to impulse transportation and how neurons built up and store information in our brains.1 When we learn all we â€˜thinkâ€™ and â€˜feelâ€™ are formed by our brain and nervous system, we realize the importance of our unique perception and impact of environments. In order to understand the relation between neuroscience and architecture, we can start with our basic activities that we use our ve senses to perceive the environments. Perception also involves with our navigation in space, and neuroscience explains on how ph