Interview with Brent Atkinson: The Brain and Intimacy

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Studies suggest that partners who demonstrate more interest in each other, engage in more acts of caring and consideration, notice more positive things about each other and express more appreciations have relationships that are more intimate than do couples who do less of these things. However, recent brain studies suggest that intimacy-building behaviors like these are likely to impact relationships differently depending on the areas of the brain that drive them. The trick to restoring intimacy has to do with figuring out how to "turn on" the brain's intrinsic motivational states that automatically make us actually *feel* more interested in our partners, invested in our relationships, and desirous of increased levels of attention from our partners. In the brain, there's a big difference between caring actions that are driven by a principled decision to act (e.g., "It's the right thing to do," or "It's how a good partner should act") and caring actions that emanate from one of the brain's intrinsic motivational systems. The former will feel like work – the latter will not.

The brain mechanisms crucial to intimacy have been discovered largely through electrical stimulation studies. Nearly five decades ago, researchers began implanting electrodes deep within specific regions of patients' brains, then applying electrical pulses. Early researchers were stunned to see the moods, desires and concerns of patients change dramatically. Stimulated individuals were temporarily transformed from calm experimental subjects into intensely angry, fearful, lustful, driven, lonely, playful or compassionate individuals, depending upon which circuits of the brain were stimulated. Activation of the brain's specialized circuits transformed subjects' thinking, beliefs, perceptions, interpretations and motivations within a few seconds.

A summary of the groundbreaking research leading to the discovery of the brain's executive operating systems can be found in neuroscientist Jack Panksepp's book *Affective Neuroscience (*1998). Panksepp and his colleagues at Bowling Green State University have located *seven* motivational systems in the brain that can be reliably turned on through electrical stimulation (Panksepp, 1998). Depending upon the circuit stimulated, subjects experience motivation to fight, flee or draw closer to each other. Mother nature has not left to chance the important task of forming intimate bonds. Four of the brain's seven executive operating systems make us feel interested in, invested in, loyal to, and more desirous of attention from our partners. Let's take a look at each of them.

Tenderness

Each of us has a brain system that, when activated, produces spontaneous feelings of warmth, tenderness and concern for others, thoughts about the welfare of others, and

urges to act in nurturing ways toward others. When this state is active, a person will feel empathic toward others, and be naturally motivated to give emotional support.

From the beginning of their lives, humans and other mammals are protected by the activation of a neural operating system in their mothers' brains that produces the motivation to care for their offspring. Before the birth of their first child, women commonly worry about their future adequacy as mothers, but such doubts typically vanish, as if by magic, soon after the birth of the baby. This is because all mothers have a neural operating system that is preprogrammed to produce caring motivations and behaviors. They don't have to learn how to nurture their young. It happens naturally. This system produces feelings that humans call acceptance, nurturance, and love, the feelings of social solidarity and warmth. The initial clue that there was a preprogrammed intrinsic brain system for nurturance was the fact that transfusion of blood from a female rat that had just given birth could instigate maternal behaviors in a virgin female rat (Panksepp, 1998). This brain system is activated by neurochemicals such as oxytocin and prolactin, which rise precipitously just before a mother gives birth. Scientists have discovered that this neural circuit can be activated just as surely by the introducing oxytocin and prolactin directly into certain areas of the brain (Keverne & Kendrick, 1992; Pedersen, Ascher, Monroe & Prange, 1982; Rosenblatt, 1992; Uvnas-Moberg, 1998). Virgin female rats treated with these chemicals fly into a flurry of caring behaviors, probably to the confusion of young pups nearby who are the unsuspecting recipients of the virgin's newfound maternal urges. Other studies show that instinctive maternal behaviors can also be blocked by giving new mothers drugs that prevent oxytocin from being absorbed (Van Leengoed, Kerker, & Swanson, 1987). Although the most dramatic activation of this brain system can be seen in new mothers, all humans, both men and women, have this neural operating system, waiting to be activated. Considerable evidence suggests that, across all mammalian species, this brain system is more vigorous in female brains than male brains (Berman, 1980; Panksepp, 1998).

Longing

Normally activated by separation from important persons or circumstances, feelings associated with this neural operating system produces variations of loneliness, sadness, and disappointment. When this state is active, a person will experience a need for the interest, nurturing, support, or attention of others, and look forward to expressions of warmth, admiration, or fondness from them.

When this circuit is activated, humans experience feelings ranging from mild loneliness to intense separation distress. The effect is always to promote an urge for emotional contact with others. This neural circuit is particularly active in the younger members of all species, who must depend upon the protection of others for survival. However, there is an abundance of evidence that in healthy adults, the circuit remains active throughout life, providing the motivation for human contact. Nature's plan doesn't involve emotional self-sufficiency. Scores of longitudinal studies suggest that individuals who cut themselves off from the need for emotional comforting from others don't function as well as individuals who continue to

experience a need for emotional comforting throughout their lives (Siegel, 1999). When soothing emotional contact is consistently available, individuals develop a sense of security that allows them to avoid wasting energy being overly vigilant to danger (Cozolino, 2002). Neuroscientists believe that this brain system is central to the forming of secure emotional bonds that buffer individuals against stresses throughout their lives (Panksepp, 2001). When the system is aroused, humans and animals seek reunion with others who help create the feeling of a "secure neurochemical base" within the brain (Nelson & Panksepp, 1998). As Panksepp put it, "social bonding involves the ability of organisms to experience separation distress when isolated from social support systems and to experience neurochemically mediated comfort when social contacts are reestablished" (1998, p. 274).

This brain system is calmed through the release of specific neurochemicals, the chief of which are the internal opioids such as endorphins and enkephalins (Panksepp, 1998). These neurochemicals are released though intimate social contact, especially direct physical contact (Keverne, Martensz, & Tuite, 1989; Montagu, 1978). When this brain system in animals is electrically stimulated, they emit "distress vocalizations" (DVs) which are identical to those emitted naturally by young animals who are separated from their mothers (Panksepp, et. al., 1980). One of the easiest ways to reduce DVs in experimental animals is to put mirrors on the wall of the test chamber. The animals calm down when they believe they are not alone. The same effect can be observed when music is pumped into the test chamber. Music simulates the comfort of audiovocal contact with other animals (Panksepp, et. Al., 1980). This may be one of the reasons why people love to listen to music—it keeps them company. Apparently, chickens have their favorites in "mood music," too, as evidence by a notably positive reaction to the 1980s Pink Floyd recording, *The Final Cut* (Johnson, 2004).

This brain circuit can also be dramatically calmed through the administration of external opiates such as morphine or heroin (Carden & Hofer, 1990; Kalin, Shelton, & Barksdale, 1988; Panksepp, Herman, Conner, Bishop, & Scott, 1978). In fact, brain researchers hypothesize that one reason why certain people become addicted to external opiates such as morphine or heroin is because they are able to artificially induce feelings of comfort similar to those normally achieved by the socially induced release of endogenous opioids. This also explains why opiate addicts tend to socially isolate themselves except for when they need to find another fix, and opiate addiction is most common in environments where social isolation and alienation are endemic (Panksepp, 1998).

There are many experiments that have shown that the DVs have a powerful effect in activating the caretaking circuits of other animals, even if the DVs are tape recorded. Not all crying comes from this separation distress system—both humans and animals respond to pain, hunger, and irritation by crying, but these cries can be distingushed from separation-induced DVs on both neuroanatomical and neurochemical bases. Adult animals instinctively know the difference (Panksepp, 1998).

People vary considerably with regard to the degree to which they experience the activation of this brain system, and in their relative abilities to self-sooth and benefit from comfort offered by others. In recent years, compelling evidence has emerged suggesting that early experiences with caregivers can have a dramatic effect on such abilities (Cozolino, 2002; Fonagy & Target, 1997; Schore, 1994, 1996, 2001a, 2001b, 2001c; Siegel, 1999, 2001). All infants and young children readily experience and express distress when they are separated

from desired people or objects. Investigations into early processes related to emotional attachment reveal that children whose parents fail to respond consistently in comforting ways learn to detach from their need for human contact, and that this detachment can persist throughout their lives. On the other hand, children who experience inconsistent, unpredictable parental comforting may experience a chronic activation of this brain system, and develop into adults who are continually looking for the kind of comfort that they never got enough of as children.

When caregivers respond to the emotions of developing children in ways that help soothe negative states and amplify positive ones, children develop the ability to fully experience both positive and negative emotions, and their brains also learn how to soothe stressful states. These children develop secure attachments. Studies suggest that the brains of securely attached children develop differently from the brains of insecurely attached children, specifically in the orbital prefrontal cortex, the area of the brain most responsible for emotional regulation (Schore, 1994, 1996, 2001a, 2000b). Schore summarized this point:

> *During the first and second years of life, the infant's affective experiences, especially those embedded in the relationship with the primary caregiver, elicit patterns of psychobiological alterations that influence the activity of subcortically produced trophic bioamines, peptides, and steroids that regulate the critical period growth and organization of the developing neocortex. Interactive attachment experiences of psychobiological attunement, stressful misattunement, and stress-regulating repair and reattunement that maximize positive and minimize negative affect are imprinted into the orbitofrontal cortex. . .During the critical period of maturation of this system, prolonged episodes of intense and unregulated interactive stress. . . result in structurally defective systems that, under stress, inefficiently regulate subcortical mechanisms that mediate the physiological processes that underlie emotion. (1996, p. 59).*

PLAY

> *Activation of this brain system produces the urge to interact with others in spontaneous or playful ways. When it is active, a person feels like teasing, roughhousing, tickling, or getting an unpredictable reaction.*

When I first read about the brain's intrinsic intimacy-generating systems, I was surprised to find that one of them is devoted exclusively to instigating *play*. It's easy to see why each of the brain's other executive operating systems survived the challenges of evolutionary time. The brain's "fight" system promotes self-protection, the "flight" system facilitates withdrawal from danger, the urge to care for other and the desire for closeness promotes secure attachment, and the desire for sexual contact promotes the passing of genes from generation to generation. But play? How does play enhance chances of survival? The play circuit appears to have an important role in facilitating social bonding (Johnson, 2004; Panksepp, 1998). When this circuit is active, internal opioids are released throughout the brain, (Panksepp & Bishop, 1981; Vanderschuren, Niesink, & Van Ree, 1995; Vanderschunen, Stein, Wiegant, & Van Ree, 1997) and when released through nurturing contact serve the function of calming an active

separation-distress circuit. Internal opioids are now believed to be one of the prime neurochemical movers in the construction and maintenance of social bonds (Panksepp, 1998). Experimental studies reveal that mammals consistently prefer to spend time with others in whose presence they have experienced high brain opioid activity (Agmo & Berenfeld, 1990; Panksepp, Neson, & Bekkedal, 1997).

When the PLAY circuit is electrically stimulated, individuals experience urges toward vigorous and spontaneous social interaction, often accompanied by a sense of joy. Panksepp uses words like *carefree* and *rambunctious* to describe the state of mind resulting from an activation of the play circuit in rats (1998). There is evidence across mammalian species that females are somewhat more playful than males (Panksepp, 1998).

Sexual Desire

When activated, this system produces feelings of sexual desire in humans, thoughts oriented toward sexual fulfillment, and urges to make sexual contact. Often, it occurs in tandem with playfulness.

Probably the most important finding about the neural operating system that produces sexual desire is that activation of this system in both men and women elevates oxytocin levels throughout the brain. In animal studies, it has been shown that free access to sexual gratification can lead to an enormous threefold elevation of oxytocin in some parts of the male brain (Panksepp, 1998). Oxytocin is centrally involved in activating the motivation to nurture and care for others. increased sexual activity diminishes the tendency of male rats to kill the young in a territory that they have successfully invaded (Hausfater & Hrdy, 1984; Mennella & Moltz, 1988). In fact, the administration of oxytocin to experimental animals reduces all forms of aggression (Panksepp, 1998). It has been documented that societies that permissive of premarital sex are generally low in adult physical violence (Prescott, 1971). Neuroscientist Jaak Panksepp has written, “Considering the importance of oxytocin in sexual behavior and the mediation of mother–infant bonds, we must suspect that sexual interactions among consenting adults may neurophysiologically facilitate the consolidation of social attachments, thereby promoting the more nurturant forms of human love” (1998, p. 259).

It should be noted that, while activation of the sexual interest can lead to a parallel activation of tenderness and nurturing motivation, the reverse is also true. Activation of the nurture circuit also makes the activation of sexual interest more likely, especially in women. It is commonly thought that men can have sex without intimacy and that women are less likely to operate this way. Indeed, there are neurochemical reasons for this. Oxytocin plays a greater role in facilitating female sexual interest than male sexual interest. For men, sexual eagerness is mediated by the neuropeptide arginine-vassopressin, which is also known to have a role in the activation of aggression (Sachser, Lick, & Stanzel, 1994; Schurman, 1980). Perhaps this is why men are often experienced as more conquest-oriented in their sexuality. For men, oxytocin levels peak during ejaculation (Carter, 1992), which may be why women often enjoy the company of men most during the “afterglow” period following sex. Due to the release of oxytocin, men are most naturally motivated to act in nurturing ways after sex.

Taken together, these four brain systems are mother nature's way of ensuring that we develop the kind of strong intimate bonds that can calm our nervous systems and propel us to watch over and protect each other. These four brain systems are, in effect, the *engines of intimacy*. When these neural systems are operating freely, we experience feelings of tenderness, the longing for emotional contact, the desire for spontaneous and joyful interaction with others, and the ecstasy of sexual union. However, just as the brain's self-protective circuits can misfire, so can these intimacy-producing circuits. When relationships are distressed, the circuits that move partners toward intimate bonds become dormant, leaving partners without the emotional connection that once sustained them. Without these powerful circuits active in their brains, attempts to connect are destined to fail. Caring acts become just that– caring <u>acts</u> rather than authentic expressions.

How PET-C (Pragmatic/Experiential Therapy for Couples) helps couples recover intimacy

PET-C helps partners restore intimacy by helping each partner more fully connect with the brain's intimacy-producing states… longing, tenderness, playfulness and sexual interest (Atkinson, 2001, 2005, 2006). When couples enter therapy, they are frequently involved in patterns in which the fight/flight mechanisms in each of their brains are mutually triggered. Two of the brain's seven executive operating systems are devoted to self-protection. When relationships are distressed, these automatic self-protective mechanisms have usually taken over. The first task is to help each partner escape the pull of these brain systems when they get upset. This is no small task, and I've done to some lengths to describe the methods we use to accomplish it (Atkinson, 1999, 2005).

But avoiding destructive interaction is only the beginning... it simply creates more possibility that the brain's intimacy states will become active. Once partners are acting more respectfully toward each other, sometimes they naturally experience an increase in feelings of longing, tenderness, playfulness and sexual interest. But they frequently don't unless they give conscious attention to the task. It is here that popular admonitions such as "give more attention to your relationship," "show more interest," and "do more thoughtful and considerate things," often fall short. Attempts to increase in such actions will often fizzle out after a period of time and/or will often not have their intended effect unless they are motivated by genuine feelings which emanate from the brains intimacy states.

Rather than focusing on increasing acts of interest and/or consideration, PET-C helps each partner examine what may be blocking full and regular activation the natural desire for attention and nurturing, genuine interest in the emotional and physical well-being of ones partner, playfulness and sexual interest. Once blocks are located and resolved, interest in each other and urges to care for and nurture each other flow naturally from the internal states.

In PET-C, we conceptualize activation blocks as being on three levels:

<u>Level I</u> blocks are fairly easy to resolve, because they involve circumstances and schedules. In spite of good intentions, partners often find that their lives don't prompt or allow time for intimate feelings to surface. Partners experiencing Level I blocks find that if they simply pay more attention to building in time and reminders that help them "get into the

mood, they easily experience tenderness, desire for closeness, playfulness and sexual interest. We use a variety of exercises to stimulate the intimacy states in this manner (Atkinson, 2005, 2006)

Level II blocks are somewhat complex, involving attitudes, beliefs or assumptions that keep partners from wanting more full activation of the intimacy states. These attitudes, beliefs or assumptions, are often amenable to change once they are consciously examined. The examination process is often an on-going time thing. The therapist gives clients tools that allow them to develop internal relationships between their "core self" and the "parts" of them that carry outmoded attitudes, beliefs and assumptions (Schwartz, 1998). Gradually, clients learn how to *accompany* and calm the internal parts (brain states) that create anxiety when the client moves toward more intimacy. Example: One therapist helped a wife realize that her limited interest in sex was related to an assumption that it's wrong for a woman to ask for what she wants sexually. Once the client identified the part of herself who believed this and felt uncomfortable taking an active role during lovemaking, she found that she was able to separate herself from this part of her and offer assurances that gradually had the effect of calming her anxiety.

Many clients find that once Level I and II blocks are resolved, feelings of tenderness, desire for contact, playfulness and sexual interest return naturally. However, some clients require further intervention.

Level III activation blocks are often experienced by individuals who have had experiences earlier in life that created a chronic over or under-stimulation of the intimacy states. Examples include sexual trauma and less-than-optimal attachment-related experiences. The distinguishing feature of Level III blocks is longevity. Often, individuals experiencing such blocks have experienced low or exaggerated need for closeness with others most of their lives. The origins of the lack of desire for emotional connection are typically rooted in early affective experiences with emotionally distant caregivers. For such people, feelings of longing for nurturing are consistently unmet; the circuits in their brains that produce the longing for emotional contact go dormant. Ironically, such individuals are often paired with mates who have unusually high levels of need for emotional contact, typically traceable to early attachment experiences in which sometimes nurturing was available and other times it vanished. Level III intervention with couples such as these involves an ironic twist, illustrated in the following excerpt:

> *Loretta was dying for more emotional understanding and support from Jack, and Jack wasn't really wanting emotional comforting from Loretta. Yet my main strategy was to connect Jack with his emotional need (which he didn't really want) and ask Loretta to delay getting support even longer (which she had been wanting all their married life). Experience working with the internal nurturing and longing states of individual partners has taught me that a person cannot respond very well with nurturing unless they have experienced the comfort of someone else in response to their own emotional need. (Atkinson, 2005, p. 53)*

With Level III intervention, the therapist helps a client like Jack recognize when the faint edge or beginning of a desire for nurturing attention can be detected, then follow that edge, allowing it to deepen. Gradually, such clients allow feelings to surface while in the presence of their partners and develop the ability to relax and "take in" nurturing responses of their partners. In contrast, the therapist will help a client like Loretta develop more ability to self-soothe, as well as cultivate additional relationships which can serve as sources of support. The goal is to help this type of client learn how to avoid overwhelming their partners with emotional need, so that the partners are able to provide meaningful emotional contact.

Mirror Neurons and Intimacy

When relationships are going well, the intimacy states are naturally active – and the feelings they produce are contagious. When one person is feeling sad, tender, playful or lustful, it's easy for the other to feel something similar. For example, Panksepp has found that distress cries of young animals automatically activate the caretaking circuits of nearby adult animals. UCLA researcher Marco Iacoboni (2008, 2009) believes that this may be because of "mirror neurons" recently discovered in various many areas of the brain. Mirror neurons allow us to feel what another person is experiencing. This is why we cry at the movies when we sense the emotions of the characters, even though we don't know them. Mirror neurons help our brains recreate the feelings inside of ourselves, allowing us to be powerfully affected by others.

Often, people who want more intimacy from their partners fail to capitalize on the advantages that mirror neurons offer. The logic behind mirror neurons is this: If you want your partner to feel more tender, playful, sexually interested, or desirous of emotional closeness, rather than complaining to your partner about the lack of what you want, get yourself more fully into the particular feeling state you'd like to get from your partner, then let your partner *feel* you for a while. Don't pressure your partner into responding immediately, and don't give up if your partner doesn't respond right away.

Here's an excerpt from a story of one of my clients showing how a woman used mirror neurons to get more of what she wanted from her partner:

> *I remember the look on Loretta's face the day I posed a simple question to her: "When you're feeling disconnected or lonely, why do you always try to get sympathy from Jack?" She looked at me as though I had lobsters crawling out of my ears. "You've been telling us for months that we need more emotional support from each other! Now you're saying I shouldn't expect that?" Anticipating her response, I smiled and teased her, repeating her words in a play-mocking tone back to her. She smiled immediately, recognizing that I was trying to get a rise out of her, and quipped, "Okay smart ass, where the hell are you going with this?" I replied, "What I mean, Loretta, is that you always use the same approach to connect with Jack, when there are several avenues available to you." I went on to explain that she seems to forget all about her strong suit—playfulness. When she was feeling lonely or upset, would it be possible for her to make an internal shift and connect with her playfulness as a means of making contact with Jack? Loretta looked confused, and sat silent, frowning for a few moments. Gradually, her expression changed, and she then told me about a time she remembered*

when she did exactly that. It was one of those days when everything that could go wrong was indeed going wrong. She rushed to her car after work thinking that she couldn't wait to vent to Jack when she got home. But on the way home, she got so sick of herself that she realized what she really needed was to just forget about the whole damned day and do something to take her mind off of it. When she got home the first thing she did was pinch Jack in the ass. Jack responded by tackling her, and they romped gleefully with each other for 15 minutes until they were laughing so hard that Loretta had to stop because she thought she was going to pee her pants! Loretta admitted that this was probably better than any kind of serious, supportive conversation they might have had. As it turned out, she did confide in Jack later in the evening, and at that moment, he was able to be sympathetic. What happened? Loretta had connected with Jack in a different way. (Atkinson, 2005, pp. 60-61)

Without even realizing it, Loretta had tripped Jack's mirror neurons and he couldn't help but respond!

References

Agmo, A., & Berenfeld, R. (1990). Reinforcing properties of ejaculation in the male rat: Role of opiates and dopamine. *Behavioral Neuroscience, 107*, 812–818.

Atkinson, B. (1999). The emotional imperative. *Family Therapy Networker*. 23(4), 22–33.

Atkinson, B. (2001). Brain to brain: New ways to help couples avoid relapse. *Psychotherapy Networker*, 26(5), 38–45, 64.

Atkinson, B. (2005). *Emotional intelligence in couples therapy*: *Advances from neurobiology and the science of intimate relationships.* New York: W.W. Norton.

Atkinson, B. (2006). *Developing habits for relationship success.* Electronic Workbook for Couples. Geneva, Illinois: The Couples Research Institute.

Berman, P. W. (1980). Are women more responsive than men to the young? A review of developmental and situational variables. *Psychological Review, 88*, 668–695.

Carden, S. W., & Hofer, M. A. (1990). Independence of benzodiazepine and opiate actions in the suppression of isolation distress in rat pups. *Behavioral Neuroscience, 104,* 160–166.
Psychology, 14, 42–58.

Carter, C. S. (1992). Oxytocin and sexual behavior. *Neuroscience and Biobehavioral Reviews, 16*, 131–144.

Cozolino, L (2002). The *neuroscience of psychotherapy: Building and rebuilding the human brain*. New York: W.W. Norton

Fonagy, P., & Target, M. (1997). Attachment and reflective function: Their role in self-organization. *Development and Psychopathology, 9,* 679–700.

Hausfater, G., & Hrdy, S. B. (Eds). (1984). *Infanticide: Comparative and evolutionary perspectives*. New York: Aldine.

Iacoboni, M. (2008) *Mirroring People: The New Science of How We Connect with Others*. New York: Farrar, Straus & Giroux.

Iacoboni, M. (2009) Imitation, Empathy, and Mirror Neurons. *Annual Review of Psychology*.

Johnson, S. (2004). *Mind wide open: Your brain and the neuroscience of everyday life.* New York: Scribner.

Kalin, N. H., Shelton, S. W., & Barksdale, C. M. (1988). Opiate modulation of separation-induced distress in non-human primates. *Brain Research., 440*, 285 292.

Keverne, E. B., & Kendrick, K. M. (1992). Oxytocin facilitation of maternal behavior in sheep. *Annals of the New York Academy of Sciences., 652*, 83–101.

Keverne, E. B., Martensz, N., & Tuite, B. (1989). B-Endorphin concentrations in CSF of monkeys are influenced by grooming relationships. *Psychoneuroendocrinology, 14*, 155–161.

LeDoux, J. (1996). The emotional brain: The mysterious underpinnings of emotional life. New York : Simon & Schuster.

Menella, J. A., & Moltz, H. (1988). Infanticide in rats: Male strategy and female counter-strategy. *Physiolology & Behavior, 42*, 19–28.

Montagu, A. (1978). *Touching: The human significance of the skin*. New York: Harper & Row.

Nelson, E. E. & Panksepp, J. (1998). Brain substrates of infant-mother attachment: Contributions of opioids, oxytocin, norepinephrine. *Neuroscience and Biobehavioral Reviews, 22*(3), 437–452.

Panksepp, J. (2001). The long-term psychobiological consequences of infant emotions: Prescriptions for the twenty-first century. *Infant Mental Health Journal, 22*(1–2)*,* 132–173.

Panksepp, J. (1998). *Affective Neuroscience*. New York: Oxford University Press.

Panksepp, J. Bean, N. J., Bishop, P., Vilberg, T., & Sahley, T.L. (1980). Opioid blockade and social comfort in chicks. *Pharmacology, Biochemistry & Behavior, 13*, 673–683.

Panksepp, J., & Bishop, P. (1981). An autoradiographic map of the (^{3}H) diprenorphine binding in rat brain: Effects of social interaction. *Brain Research Bulletin, 7*, 405–410.

Panksepp, J., Herman, B., Conner, R., Bishop, P., & Scott, J.P. (1978). The biology of social attachments: Opiates alleviate separation distress. *Biological Psychiatry, 13* (5), 607–617.

Panksepp, J., Neson, E., & Bekkedal, M. (1997). Brain systems for the mediation of social separation-distress and social-reward: Evolutionary antecedents and neuropeptide intermediaries. *Annals of the New York Academy Science, 807*, 78–100.

Pedersen, C. A., Ascher, J. A., Monroe, Y. L., & Prange, A. J. (1982). Oxytocin induces maternal behavior in virgin female rats. *Science, 216*, 648–649.

Prescott, J. W. (1971). Early somatosensory deprivation as an ontogentic process in the abnormal development of brain and behavior. In E. I. Goldsmith & J. Mody-Jankowski (Eds.). *Proceedings of the Second Conference on Experimental Medicine and Surgery in Primates*. (pp. 356–375). Basel: Karger.

Rosenblatt, J. (1992). Hormone-behavioral relations in the regulation of parental behavior. In J. B. Becker, S. M. Breedlove & D. Crews (Eds.), *Behavioral endocrinology.* (pp. 219–259). Cambridge, MA: MIT Press.

Sachser, N., Lick, C., & Stanzel, K. (1994). The environment, hormones, and aggressive behaviour: A 5-year-study in guinea pigs. *Psychoneuroendocrinology, 19*, 697–707.

Schore, A. N. (1994). *Affect regulation and the origin of self*. Hillsdale, NJ: Erlbaum.

Schore, A. N. (1996). The experience-dependent maturation of a regulatory system in the orbital prefrontal cortex and the origin of developmental psychopathology. *Development and Psychopathology, 8,* 59–87.

Schore, A. N. (2001a). Effects of a secure attachment relationship on right brain development, affect regulation, and infant mental health. *Infant Mental Health Journal, 22* (1–2), 7–66.

Schore, A.N. (2001b). The effects of early relational trauma on right brain development, affect regulation, and infant mental health. *Infant Mental Health Journal, 22* (1–2), 201–269.

Schore, A. N. (2001c). Contributions from the decade of the brain to infant mental health: An overview. *Infant Mental Health Journal*, 22 (1–2), 1–6.

An overview. *Infant Mental Health Journal*, 22 (1–2), 1–6.
Schurman, T. (1980). Hormonal correlates of agonistic behavior in adult male rats. In P. S. McConnell, G. J. Boer, H. J. Romijin, N. E. van de Poll, & M. A. Corner (Eds). *Adaptive capabilities of the nervous system*. (pp. 415–420). Amsterdam: Elsevier/North Holland.

Schwartz, R. (1995). *Internal family systems therapy*. New York: Guilford Press.

Siegel, D. (1999). *The developing mind: Toward a neurobiology of interpersonal experience.* New York: Guilford.

Siegel, D. J. (2001). Toward an interpersonal neurobiology of the developing mind: Attachment relationship, "Mindsight," and neural integration. *Infant Mental Health Journal, 22* (1-2), 67-94.

Uvnas-Moberg, K. (1998). Oxytocin may mediate the benefits of positive social interaction and emotions. *Psychoneuroendocrinology, 23*(8), 819–835.

Vanderschuren, L. J. M. J., Niesink, R. J. M., & VanRee, J. M. (1997). The neurobiology of social play behavior in rats. *Neuroscience and Biobeahvioral Reviews, 21*(3), 309–326.

Vanderschuren, L. J. M. J., Stein, E. A. l, Wiegant, V. M., & Van Ree, J. M. (1995). Social play alters regional brain opioid receptor binding in juvenile rats. *Brain Research., 680*,148–156.

Van Leengoed, E., Kerker, E., & Swanson, H.H. (1987). Inhibition of post-partum maternal behavior in the rat by infusion of an oxytocin antagonist into the cerebral ventricles. *Journal of Endocrinology, 112*, 275–282.