



# **The Chemistry of Relationships: Emotions, the Brain, and the Experience of Love**

**Research Brief**

Rita DeMaria, PhD

# The Chemistry of Relationships: Emotions, the Brain, and the Experience of Love

## Definitions

**Affective neuroscience:** the study of the neurological mechanisms of emotion (also called the cognitive neuroscience of emotion); Panksepp (1992) is credited with coining the term affective neuroscience, the exploration of emotion in humans and animals

**Amygdala:** an almond-shaped brain center for emotional memory related to reward and fear; plays some role in mating

**Attachment Theory:** a model that describes the lifelong dynamics of adaptive affectional bonds and behaviors, with particular attention to attachment patterns and styles in children and adult romantic relationships

**Emotional hijacking:** an acute sensitivity to past emotional experience (also referred to as emotional allergy or emotional flooding)

**Emotional intelligence:** traits and skills that promote positive social behavior, recognizing emotions, and the capacity to use the information in productive and useful ways

**Hippocampus:** the part of the brain responsible for long-term memories and maintenance of cognitive maps for navigation

**Hypothalamus:** regulates bodily functions including sexual arousal

*Marriage is a crucible that will 'chemically' transform the partners.*

— Carl Jung

**Limbic System:** the brain structures involved in accessing and processing emotional experience; includes the amygdala and hippocampus

**Positive Psychology:** the study of positive emotion, meaning in life, positive relationships, and positive accomplishments—mastery, achievement, and competence

**Neuroplasticity:** the brain's ability to reorganize itself by forming new neural connections throughout life

**Oxytocin:** a biomolecular type of chemical messenger (called a hormone) that is synthesized in the hypothalamus and referred to as the “cuddle chemical”; plays a role in maternal behavior, pair bonding, and orgasm

**Psychology:** the science of the mind and behavior

## Background

Since the beginning of recorded history, philosophers, theologians, and scholars have theorized and studied the human experience of powerful emotions—especially the feelings of love in romantic relationships. Contemporary history is no exception. Psychologists began studying the role of bonding and attachment as a foundation for interpersonal relationships in the 1900s. Furthermore, researchers and practitioners from many fields have studied and theorized about intense emotions such as anger, sadness, love, and joy. Only within the past 40 years, however, has the topic been brought to neuroscience.

In essence, psychological and sociological theories and interventions surrounding bonding, attachment, and emotions are now supported by the science of the brain and the understanding of the body's biochemical processes. Neuroscientists have mapped many regions of the brain using a variety of brain imaging processes that allow them to identify the associated biological functions. Practitioners who help couples and individuals enhance, strengthen, or restore their relationships may want to integrate the physiology of emotions, the brain, and the experience of love into their work. This Brief outlines some of the history and recent findings that help explain the “chemistry” of intimate relationships and provides a discussion of the possible implications and considerations for marriage/relationship educators.

## Research and Trends

The complexity of the new science of the brain and emotions requires a shift in the mindset of today's service practitioners. Brain imaging, which began in the 1970s, provided the opportunity for



scientists to explore the uncharted territory of human emotional functioning. In those early years, exposure to radioactivity made testing limited. The recent creation of functional magnetic resonance imaging (fMRI) has provided a technological leap in measuring brain activity without radioactive traces, catapulting the field forward and increasing its growth rate exponentially.

By distilling the important findings in neuroscience, popular magazines help raise awareness about the complexity and evolution of relationship science. Since 1999, Time Magazine has regularly featured cover stories (from the “Chemistry of Love” to “Your Brain in Love”) based on new and ongoing studies at major research centers. In 2009, Time Books published *Your Brain: A User's Guide*. More recently, the Jan/Feb 2010 issue of *Networker* featured *Psychotherapy and the Brain: Are we entering a new era of practice?* These studies provide essential information and offer new insights into the age-old mystery of romantic relationships. The section below highlights some of the key issues and findings in neuroscience and how they relate to emotion, bonding, attachment, and romantic love.

## Emotions and the Brain

Emotions are an essential part of human functioning and intimate relationships. Practitioners have long recognized that emotions are a vital force for love, bonding, intimacy, and sexual desire in romantic relationships. Furthermore, emotions motivate prosocial, empathic, and moral behaviors and play a role in an individual's sense of self.

Research on human emotions, along with the new frontier of brain research (see below), began a shift in how the functioning of intimate relationships is viewed.

The study of emotions and emotional functioning has a long history, beginning with Charles Darwin's work in 1872 on the universal facial expressions of emotion. This groundbreaking effort was followed by the work of a number of psychologists and neuroscientists.<sup>1</sup> Ultimately, the foundation for affect theory—the science of basic emotions—was established. Researchers have identified the “basic” emotions that are cross-culturally identifiable: anger, sadness, fear, excitement, enjoyment, surprise, and disgust (Ekman), and have come to some agreement that these emotions occur on a continuum of intensity. This foundational information led to the neurological investigation of emotional functioning.

Neuroanatomists are mapping the regions of the brain and have identified the brain structures involved in accessing and processing emotional experiences within the limbic system. This system acts as the central processing unit of emotions. One particular area of this system, the amygdala, is recognized as the center for emotion. Another structure, the hippocampus, is considered the center for emotional memory. Studies of these

areas of the brain have focused on the brain's responses during two emotional extremes: calm and heightened states. For example, studies of long-term Buddhists who meditate have revealed important new findings about regions of the brain (Lutz & Davidson, 2004) that provide keys to controlling emotion and mood.

Emotional reactivity and intense expressions of negative emotions are detrimental to the healthy development of relationships. Emotions such as anger, hostility, and contempt have long been identified as central to the breakdown of human relationships. *Emotional Intelligence* (Goleman, 1995) was one of the first books to popularize the idea that emotional functioning was crucial for personal and relationship success in life. The field of neurobiology has taken this one step further to illustrate that the brain is physically impacted by personal relationships over time (Siegel, 2008). Emotional attunement (being responsive to another person's emotional needs) has been identified as a significant component to promoting attachment (MacDonald & MacDonald, 2010). Compassion and empathy have also been identified as key relationship skills (Guerney, 1977). These findings help guide understanding of how human beings function emotionally in health and disease—and in relationships.

Researchers are beginning to identify more interventions that can help increase the likelihood of improvements in moods, relationships, and personal functioning. Positive psychology is an emerging field that focuses on the study of positive emotions, individual traits, relationships, and institutions (Seligman, 2002). Ekman (2006) has identified four steps in improving emotional life that

---

<sup>1</sup> Including Sylvan Tomkins, Carrol Izard, Paul Ekman, Antonio Damasio, Daniel Goleman, Jaak Panksepp and many others.

encompass all of the concepts discussed above to include: (a) consciousness of emotional experience (b) choosing constructive behaviors to express emotions (c) developing sensitivity to the feelings of others and (d) responding considerately to the feelings of others. The studies of emotion have also led to various mind-body approaches to healing trauma, which are interventions based on the notion that new emotional experience can actually create new brain processes or “neural pathways” (called neuroplasticity). Johnson’s development of Emotional Focused Therapy (EFT) for couples incorporates attachment and emotion as core to its model. The goal of this work is to show that the brain is actually changing as a response to the bonding occurring during EFT. The study of emotion and the study of the brain are intertwined; the next section highlights a few of the important areas of work going on throughout the world.

## Attachment and the Bonds of Love

Attachment theory emerged from the work of John Bowlby, a physician and psychoanalyst practicing in post-war London, England, during the 1940s. This theory speaks to the innate human striving for emotional closeness and comfort and the distress created by separation and loss. Harlow’s study (1958) underscored the essential nature of contact comfort for establishing social bonds. Bonding, which takes place through the experience of touch and physical closeness, is identified as the key to human well-being. Researchers now believe that affectional experiences in childhood have a profound impact on adult love relationships and family patterns. Researchers concur that these early bonding and attachment experiences provide a rubric for understanding adult attachment styles and individual vulnerabilities. The working hypothesis



is that a child’s attachment style forms a template for his or her adult relationship experiences.

While many love relationships begin with lust, sexual attraction, and romance (Fisher, 2004), some of these relationships become a loving and stable pair bond. As love relationships develop over time, bonding and attachment form based on a complex mix of psychological, emotional, physical, and social factors. Although sexual attraction and desire bring lovers together, similar social backgrounds and interests promote bonding and attachment. Studies exploring the chemistry of romantic love and passionate love are further strengthening this knowledge base. Again, fMRIs have played a part in revealing the hidden biochemical processes that take place in the brain when people fall in love and as their relationships evolve.

Romantic love is an important part of many long-term marriages in which couples maintain sexual vitality. Falling in love is a complex neurochemical cocktail that includes norepinephrine, dopamine, endorphins, oxytocin, and phenethylamine. This combination creates a powerful emotional experience that may be motivated by the human instinct for survival. Research shows that romantic



love experiences are stored in the emotional center of the brain and are most likely fortified by oxytocin, which fosters bonding and attachment. oxytocin, a hormone referred to as the “cuddle chemical,” has created intense interest in attachment research and is helping to explain the power and place of human bonding. Additionally, oxytocin has also been shown to be instrumental in facilitating trust. The understanding of why human beings form pair bonds and the complexities of attachment experiences in children and adults is being explored through the neurochemistry of various hormones and their role in strengthening or weakening intimate relationships.

## Love and Relationship Skills

Researchers are now exploring the question, “Can we really have it all in marriage?” Does romantic love fade as a distant memory or is it possible in long-term marriages (Acevedo and Aron, 2009)? Can couples maintain romantic love, friendship, sexual attraction, and commitment over a lifetime? Preliminary research indicates that loving and passionate relationships can grow in attraction. Acevedo and Aron (2009) suggest that romantic love (minus the obsessiveness of lust) appears to be a real, lifelong experience for many. Couples who report high levels of passionate love in their relationship also report higher levels of personal satisfaction, more affection, high levels of trust and friendship, and lower levels of depression. Couples who experience hypoactive sexual desire are a great risk for breakup over time. McCarthy & McCarthy (2003) suggest that there are a variety of ways that sexuality can be maintained throughout the marriage relationship.

The passion, bonding and love that unite couples are only part of the couple relationship. The field of

psychology has also studied relationship dynamics and interpersonal communication between partners. Identifying factors that are protective versus destructive in relationships has contributed to psychosocial education and treatment for couples. In the 1960s, programs known commonly as marriage education began with a variety of approaches, mostly emphasizing marital preparation and premarital counseling, along with married couple retreats to improve communication skills.

Early programming in marriage/relationship education emphasized forming companionate marriages and teaching individuals and couples important knowledge and skills. These programs provided practical and useful methods, techniques, and tools for dealing with relationship issues. Emotions, particularly anger, hostility, and contempt, were viewed as a causative factor in the breakdown of marriage and relationships. However, there were few techniques for effectively managing the emotional hijacking brought on by the fight/flight response. Initial techniques primarily focused on cognitive approaches to conflict and problem solving. While sharing and processing emotional experience and expression were taught, the skills often remained at superficial levels of emotional expression. The importance of emotional expression and affect regulation, bonding, and attachment in intimate relationships was often underemphasized.

## Implications

Currently, much is being learned about how the chemistry of romantic love and the chemistry of attachment foster a committed love relationship. Therefore, marriage/relationship educators may want to integrate practice and skill building that will help protect and nurture the emotional

bond. Educators may want to prioritize resolving differences by teaching individuals and couples to identify emotions and express emotion constructively. Furthermore, practitioners may want to encourage activities that enhance emotional responsiveness and emotional attunement to promote bonding. For example, showing empathy in intimate relationships has received attention as an essential relationship skill and plays a crucial role in establishing emotional security and secure attachment. The physical bond plays a crucial role, too. Educators may want to express the importance of cuddling or doing other intimate activities (not necessarily sex, but sex is certainly included) that facilitate the stimulation of oxytocin and the other chemicals associated with bonding and attachment.

The ability to express emotions in constructive ways fosters and facilitates a sense of connection and secure attachment in relationships. Family life is the primary forum where people learn to express thoughts, feelings, desires, and needs. Emotional expression that is confused, unclear, or blaming leads to depression, aggression, and emotional distance in social relationships. Exploring patterns of relationship and emotional expression learned in an individual's family of origin helps couples becoming more accepting of each other. These family patterns also underlay the internal working model of attachment that each person brings to the relationship. Helping couples understand, support, and connect with each other in compassionate and empathetic ways often reduces relationship distress.

Practitioners may want to integrate techniques with the goal of transforming anger into constructive problem solving (with basic steps for constructive expression, methods for dealing with destructive



expressions of anger, and important processes for forgiveness within relationships). Although communication training teaches these skills from a behavioral model, programs may want to consider incorporating mind-body techniques to soothe and calm reactivity. The role of meditative practices as a method for managing emotional reactivity, stress, and certain illnesses is receiving greater attention.

Discussing physiological factors in class may provide new levels of hope for distressed couples. Understanding that working on their relationship may actually create new neural pathways that help couples better relate to one another can renew a couple's energy and focus on healing their relationship.

## Conclusion

There is a new era of practice influenced by the study of the brain and how it relates to emotions, bonding, and attachment. Greater attention to exercises and activities that strengthen the chemistry of love, connection, trust, friendship, and sexual desire are needed in the new generation of healthy marriage/relationship education programs.

The focus on positive interventions that enhance the chemistry of love, attraction, and affection will help strengthen programs and services that are already helping many individuals and couples improve their lives and their relationships.

***The NHMRC would like to thank Rita DeMaria, PhD, for her contributions to this Research Brief. Dr. DeMaria is Director of Relationship Education at Council for Relationships. She specializes in marriage education, counseling, enrichment, divorce prevention and premarital assessment and counseling. The NHMRC would also like to acknowledge Courtney Harrison, MPA, and Rachel Derrington, MSW, of the Resource Center for their contributions to this Research Brief. This is a product of the National Healthy Marriage Resource Center, led by co-directors Mary Myrick, APR, and Jeanette Hercik, PhD, and project manager, Rich Batten, ThM, MEd, CFLE.***

## References and Additional Resources

Acevedo, B. P., & Aron, A. (2009). Does a long-term relationship kill romantic love? *Review of General Psychology*, 19, 1, 59–65.

Black, J. (2002). Darwin in the world of emotions. *Journal in the Royal Society of Medicine*, V. 95, 311–313.

Damasio, A. R. (1994). *Descartes' error: Emotion, reason, and the human brain*. New York: Putnam.

Darwin, C. (1872). *The Expression of emotion in man and animals*. 3<sup>rd</sup> ed. (Introduction, afterward, and commentaries by Paul Ekman, Essays on the history of the illustrations by Paul Prodger). London: Fontana, 1999.

DeMaria, R. Distressed couples in marriage education. *Family Relations*, April 2005.

Ekman, P. (2003). *Emotions revealed: recognizing faces and feelings to improve communication and emotional life*. New York: Holt Publishers.

Ekman, P., & Friesen, W. V. (1971). Constants across cultures in the face and emotion. *Journal of Personality and Social Psychology*, 17, 124–129.

Fisher, H. (2004). *Why We Love: The Nature and Chemistry of Romantic Love*. New York: Henry Holt.

Goleman, D. (1995). *Emotional intelligence*. New York: Bantam Books.

Guemey, B.G., Jr. (1977). *Relationship enhancement: Skill training programs for therapy, problem prevention, and enrichment*. San Francisco: Jossey-Bass.

Haidt, J. (2006). *The Happiness Hypothesis*. New York: Basic Books.

Harris, H. H., Luskin, F. M., Benisovich, S. V., Standard, S., Bruning, J., Evans, S., & Thoresen, C. (2006). Effects of a group forgiveness intervention on forgiveness, perceived stress and trait anger: A randomized trial. *Journal of Clinical Psychology*, 62(6), 715–733.

Harlow, H. (1958). The nature of love, *American Psychologist*, 13, 573–685.

Izard, C. E. (1971). *The Face of Emotion*. New York: Plenum Press.

Izard, C. E. (1975). *Human Emotions*. New York: Plenum Press.

Izard, C. E. (1991). *The psychology of emotions*. New York: Plenum Press.

Izard, C. E. (1993). Four systems of emotion activation: Cognitive and noncognitive processes. *Psychological Review*, 100, 68–90.



- Izard, C. E. (2001). Emotional intelligence or adaptive emotions? *Emotion*, 1, 249–257.
- Izard, C. E. (2009). Emotion theory and research: Highlights, unanswered questions, and emerging issues. *Annual Review of Psychology*, 60, 1–25.
- Izard, C. E. (2002). Translating emotion theory and research into preventative interventions. *Psychological Bulletin*, 128, 796–824.
- Izard, C. E. (2001). Emotional intelligence or adaptive emotions? *Emotion*, 1, 249–257.
- Johnson, S. (2004). *The practice of emotionally focuses therapy. 2<sup>nd</sup> edition*. New York: Brunner/ Routledge.
- MacLean, P. D. (1969). A triune concept of the brain and behavior. Unpublished paper presented at Queen's University, Kingston, Ontario.
- MacLean, P. D. (1990). *The triune brain in evolution: Role of paleocerebral functions*. New York : Plenum Press.
- McCarthy, B., & McCarthy, E. (2003). *Rekindling desire: A step by step program to help low-sex and no sex marriages*. New York: Routledge.
- Montague, A. (1971, 1978, 1986). *Touching: the human significance of skin*. 3<sup>rd</sup> edition. New York: Harper & Row.
- Newberg, A. B., Wintering, N., Waldman, M. R., Amen, D., Khalsa, D. S., & Alvi, A. Cerebral blood flow differences between long-term mediators and non-mediators. *Consciousness and Cognition*, In Press, 2010 Elsevier Inc.
- Panksepp, J. (1998). *Affective Neuroscience: The foundations of human and animal emotions*. Oxford: Oxford University Press.
- Pert, C. (1997). *Molecules of Emotion: The science behind mind-body medicine*. New York: Touchstone.
- Siegel, D. J. (1999). *The developing mind: how relationships and the brain interact to shape who we are*. New York: Guilford Press.
- Siegel, D. J. (2008). *The neurobiology of “we.”* Sounds True publishers, [www.soundstrue.com](http://www.soundstrue.com).
- Seligman, M. E. P. (2002). *Authentic Happiness*. New York: Simon Schuster.
- Seligman, M. E. P., Steen, A., Park, N., & Peterson, C. Positive psychology progress: Empirical validation of interventions, *American Psychologist*, Vol 60, 5, 410-421.
- Tomkins S. S. (1962). *Affect Imagery Consciousness, vol I: The Positive Affects*. New York: Springer.