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Biological Systems for Courtship, Mating, Reproduction, and Parenting

Elaine Hatfield University of Hawaii

Recently, social psychologists, neuroscientists, and physiologists have begun to explore the biological systems that are involved in love and sexual desire, courtship, mating, reproduction, and parenting.

In *Why We Love,* Helen Fisher argues that people possess a trio of primary brain systems designed to deal with these aspects of close intimate relationships. These are: attraction (passionate love), lust (sexual desire), and attachment (companionate love). Presumably, these diverse systems evolved during humankind's long evolutionary history; each plays a critical role in courtship, mating, reproduction, and parenting. In theory, attraction evolved to persuade our ancestors to focus attention on a single favored courtship partner. Sexual desire evolved to motivate young people to seek a *range* of appropriate mates and sexual partners. Attachment evolved to insure that parents would remain together for the first few crucial years of a child's life and for parents and children to form secure attachments). This entry reviews what scholars have learned about these complex brain systems, which have been found to interact in a myriad of ways.

Love, Sexual Desire, Courtship, and Mating

According to Fisher, attraction (passionate love) is characterized by a yearning to win a preferred mating partner. She observes that the attraction brain system is primarily associated with increased dopamine in the reward centers. There is also increased activity of central norepinephrine and decreased activity of central serotonin. Other brain systems also contribute to produce the range of cognitions, emotions, motivations, and behaviors central to romantic love.

Sexual desire (lust), on the other hand, is typified by a *general* craving for sexual gratification and may be directed toward many potential partners. In men and women the androgens, particularly testosterone, are central to sparking sexual desire.

Many neuroscientists contend that passionate love and sexual desire are in fact tightly linked. Andreas Bartels and Semir Zeki, for example, (using functional magnetic imaging (fMRI) techniques) attempted to identify the brain regions associated with passionate love and sexual desire. They put up posters around London, advertising for men and women who were "truly, deeply, and madly in love." Seventy young men and women from 11 countries and several ethnic groups responded. Those who scored highest on the *Passionate Love Scale (PLS)* were selected for study. These people were placed in

an fMRI scanner. This high-tech scanner constructs an image of the brain in which changes in blood flow (induced by brain activity) are represented as color-coded pixels. Bartels and Zeki gave each person a photograph of their beloved to gaze at, alternating the beloved's picture with pictures of other casual friends. They then digitally compared the scans taken while the participants viewed their beloved's picture to those taken while they viewed a friend's picture, creating images that represented the brain regions that became more (or less) active when people viewed their beloved's picture. These images, the researchers argued, revealed the brain regions involved when a person experiences passionate love and/or sexual desire.

Bartels and Zeki discovered that passion sparked increased activity in the brain areas associated with euphoria and reward, and decreased activity in the areas associated with sadness, anxiety, and fear. Activity seemed to be restricted to foci in the *medial insula* and the *anterior cingulated cortex* and, subcortically, in the *caudate nucleus*, and the *putamen*, all bilaterally. Most of the regions that were activated during the experience of romantic love are those that are active when people are under the influence of euphoria-inducing drugs such as opiates or cocaine. Apparently, both passionate love and those drugs activate a "blissed-out" circuit in the brain. The *anterior cingulated cortex* has also been shown to be active when people view sexually arousing material. This makes sense since passionate love and sexual desire are generally assumed to be tightly linked constructs.

Among the regions where activity *decreased* during the experience of love were zones previously implicated in the areas of the brain controlling critical thought (i.e., the sort of mental activity involved in making social judgments and in "mentalizing"—that is, in the assessment of other people's intentions and emotions) and in the experience of painful emotions such as sadness, anger and fear. The authors argue that once we fall in love with someone, we feel less need to critically assess their character and personality. (In that sense, love may indeed be "blind.") Deactivations were also observed in *the posterior cingulated gyrus* and in the *amygdala* and were right-lateralized in the *prefrontal, parietal,* and *middle temporal cortices.* Once again, the authors found passionate love and sexual arousal to be tightly linked.

This is only one-half of the equation, of course. Love is often unrequited. What kind of brain activity occurs when passionate lovers are rejected?

Fisher and her colleagues studied 15 men and women who had just been jilted by their beloved. The authors followed much the same protocol as that utilized in happily in love participants—i.e., they asked participants to alternately view a photograph of their one-time beloved and a photograph of a familiar, emotionally neutral individual. The authors found that when contemplating their beloved, rejected lovers displayed greater activity in the right *nucleus accumbens/ventral putamen/pallidum, lateral orbitofrontal cortex* and *anterior insular/operculum cortex* than they did when contemplating neutral images. In short, jilted lovers' brains "lit up" in the areas associated with anxiety, pain, and attempts at controlling anger as well as addiction, risk taking, and obsessive/compulsive behaviors. Jilted lovers appear to experience a storm of passion—passionate love, sexual desire, plus anguish, rejection, rage, emptiness, and despair.

Other neuroscientists who have studied the fMRI responses of lovers who are actively grieving over a recent romantic breakup, secured slightly different results. Fisher speculates that such differences are probably due to the fact that while she and her colleagues study young people who are actively grieving the loss of love, her critics have focused on men and women who broke up some time ago and have presumably adapted to their losses. Instead of at the grief stage, they may have been at a subsequent stage in the grieving process—experiencing resignation and despair. The use of fMRI techniques are, of course, very new and definitive answers as to the precise nature of love and sexual desire will have to await further research.

Attachment, Reproduction, and Parenting

According to Helen Fisher, attachment (which she also labels companionate love) is comprised of feelings of calm, social comfort, emotional union, and the security felt in the presence of a long-term mate. It sparks affiliative behaviors, the maintenance of close proximity, separation anxiety when closeness disappears, and a willingness to participate in shared parental chores. Animal studies suggest that this brain system is primarily associated with oxytocin and vasopressin in the *nucleus accumbens* and *ventral pallidum*.

Currently, researchers provide some support for Fisher's contentions. Sue Carter and her colleagues, for example, set out to investigate the neurobiology of monogamy and pair bonding. In mammals, monogamy is characterized by close pair bonds (often for life), both parents participating in care of offspring, reproduction regulated by social stimuli, incest avoidance, and selective aggression against outside rivals. Non monogamous mammals would, of course, be lacking in these characteristics. To study the antecedents of pair boding/non-pairbonding, scholars selected two prototypic rodents: prairie voles and meadow and montane voles. Prairie voles inhabit the grasslands of mdwestern North America. These voles are highly social and monogamous. A breeding pair live in a communal family, with male and female breeders and their offspring. Pair-bonded males are highly aggressive following mating and often patrol the parameters of the nest. The pair bonds may last until "death do them part." Their opposite—the meadow voles and montane voles are less social, do not form pair bonds, are non-monogamous, and the fathers do not participate in the rearing of infants.

Over the decades, ethnologists and neurobiologists have amassed a great deal of information about the nature of pair bonding in the various types of voles. During the course of these observations and experiments, scientists have identified a number of substances that facilitate pair bonding, monogamy, and parental behavior. First and foremost, a number of peptides, including oxytocin and vasopressin, which are released during mating, have been found to facilitate pair bonding, social affiliation, and maternal behavior. In fact, neurobiologists generally refer to oxytocin as the "affiliative neuropeptide." In male prairie voles, stress and vasopressin stimulate territoriality and defensive behaviors. Another class of brain neurotransmitters called opioids also appear to play a crucial role in facilitating pairbonding and affiliative behavior. (Opioids are naturally occurring compounds that act in the brain much like opium, morphine, or heroin.) It is speculated that such opioids facilitate mother-child bonding and maternal care.

Interestingly, both Sue Carter and Shelley Taylor point out that social and environmental factors may play a critical role in shaping prairie vole monogamy. The hypothalamic-pituitary-adrenocortical axis (the HPA axis) is sensitive to the social and physical environment and is exceptionally active in prairie voles. Thus, they speculate, HPA hormones (including various peptides and steroids) may be a mechanism through which social factors can influence pair-bonding and monogamy in prairie voles.

The Interaction Between Various Systems

Nature is parsimonious. Some neuroscientists and neurobiologists point out that in mankind's affectional system, the triume structures that Fisher discusses are in fact tightly linked. Andreas Bartels and Semir Zeki, for example, point out that passionate love and maternal love are both highly rewarding experiences—both are closely linked to the perpetuation of the species. When these scientists compared the fMRI brain activity of mothers viewing pictures of their own children versus a variety of more neutral pictures they discovered that romantic love and maternal love had much in common. Both types of attachment sparked activity in the brain's reward system—the areas that that are rich in *oxytocin* and *vasopressin* receptors. Both deactivated a common set of regions associated with social judgments, "mentalizing" (the cognitive assessment of other people's intentions and emotions), and negative emotions.

The End of the Affair

Fisher closes her analysis of the brain systems sparking attraction, lust, and attachment by observing that passionate attachments are by their nature time bound. She argues that in the course of evolution our ancestors came to be genetically programmed to meet, mate, and move on-a strategy designed to create optimal genetic variety in the young. When she examined the data from 58 human societies selected from the Demographic Yearbook of the United Nations, she discovered that in the majority of societies, couples tend to separate and divorce around the fourth year of marriage. Fisher notes that: (1) many socially monogamous species form pair-bonds that last only long enough to rear the young through infancy, and (2) in hunting/gathering societies, it generally takes four years to rear a child. (Children in such societies join in multi-age play groups soon after being weaned, becoming the responsibility of relatives and older siblings.) (3) Thus, she hypothesizes that it may be "natural" for young couples to meet, court, marry, reproduce, and remain together only long enough to raise a child. After that period, the chemistry of attraction (the stew of increased dopamine, decreased serotonin, and increased norepinephrine) swings into action and men and women begin to feel an ancient tugs of attraction, sexual desire, and finally attachment yet again.

Elaine Hatfield Department of Psychology University of Hawaii **See also:** Arousal and attraction; attraction, sexual, caregiver role, compassionate love, evolutionary perspectives on women's romantic attraction, falling in love, lust.

Further Readings

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