

Watching New Love as It Searns the Brain

By BENEDICT CAREY for The New York Times

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New love can look for all the world like mental illness, a blend of mania, dementia and obsession that cuts people off from friends and family and prompts out-of-character behavior - compulsive phone calling, serenades, yelling from rooftops - that could almost be mistaken for psychosis.

Now for the first time, neuroscientists have produced brain scan images of this fevered activity, before it settles into the wine and roses phase of romance or the joint holiday card routines of long-term commitment.

In an analysis of the images appearing today in *The Journal of Neurophysiology*, researchers in New York and New Jersey argue that romantic love is a biological urge distinct from sexual arousal. It is closer in its neural profile to drives like hunger, thirst or drug craving, the researchers assert, than to emotional states like excitement or affection. As a relationship deepens, the brain scans suggest, the neural activity associated with romantic love alters slightly, and in some cases primes areas deep in the primitive brain that are involved in long-term attachment. The research helps explain why love produces such disparate emotions, from euphoria to anger to anxiety, and why it seems to become even more intense when it is withdrawn. In a separate, continuing experiment, the researchers are analyzing brain images from people who have been rejected by their lovers.

"When you're in the throes of this romantic love it's overwhelming, you're out of control, you're irrational, you're going to the gym at 6 a.m. every day - why? Because she's there," said Dr. Helen Fisher, an anthropologist at Rutgers University and the co-author of the analysis. "And when rejected, some people contemplate stalking, homicide, suicide. This drive for romantic love can be stronger than the will to live."

Brain imaging technology cannot read people's minds, experts caution, and a phenomenon as many sided and socially influenced as love transcends simple computer graphics, like those produced by the technique used in the study, called functional M.R.I. Still, said Dr. Hans Breiter, director of the Motivation and Emotion Neuroscience Collaboration at Massachusetts General Hospital, "I distrust about 95 percent of the M.R.I. literature and I would give this study an 'A'; it really moves the ball in terms of understanding infatuation love." He added: "The findings fit nicely with a large, growing body of literature describing a generalized reward and aversion system in the brain, and put this intellectual construct of love directly onto the same axis as homeostatic rewards such as food, warmth, craving for drugs."

In the study, Dr. Fisher, Dr. Lucy Brown of Albert Einstein College of Medicine in the Bronx and Dr. Arthur Aron, a psychologist at the State University of New York at Stony Brook, led a team that analyzed about 2,500 brain images from 17 college students who were in the first weeks or months of new love. The students looked at a picture of their beloved while an M.R.I. machine scanned their brains. The

researchers then compared the images with others taken while the students looked at picture of an acquaintance.

Functional M.R.I. technology detects increases or decreases of blood flow in the brain, which reflect changes in neural activity. In the study, a computer-generated map of particularly active areas showed hot spots deep in the brain, below conscious awareness, in areas called the caudate nucleus and the ventral tegmental area, which communicate with each other as part of a circuit. These areas are dense with cells that produce or receive a brain chemical called dopamine, which circulates actively when people desire or anticipate a reward. In studies of gamblers, cocaine users and even people playing computer games for small amounts of money, these dopamine sites become extremely active as people score or win, neuroscientists say.

Yet falling in love is among the most irrational of human behaviors, not merely a matter of satisfying a simple pleasure, or winning a reward. And the researchers found that one particular spot in the M.R.I. images, in the caudate nucleus, was especially active in people who scored highly on a questionnaire measuring passionate love.

This passion-related region was on the opposite side of the brain from another area that registers physical attractiveness, the researchers found, and appeared to be involved in longing, desire and the unexplainable tug that people feel toward one person, among many attractive alternative partners.

This distinction, between finding someone attractive and desiring him or her, between liking and wanting, "is all happening in an area of the mammalian brain that takes care of most basic functions, like eating, drinking, eye movements, all at an unconscious level, and I don't think anyone expected this part of the brain to be so specialized," Dr. Brown said. The intoxication of new love mellows with time, of course, and the brain scan findings reflect some evidence of this change, Dr. Fisher said. In an earlier functional M.R.I. study of romance, published in 2000, researchers at University College London monitored brain activity in young men and women who had been in relationships for about two years. The brain images, also taken while participants looked at photos of their beloved, showed activation in many of the same areas found in the new study - but significantly less so, in the region correlated with passionate love, she said.

In the new study, the researchers also saw individual differences in their group of smitten lovers, based on how long the participants had been in the relationships. Compared with the students who were in the first weeks of a new love, those who had been paired off for a year or more showed significantly more activity in an area of the brain linked to long-term commitment.

Last summer, scientists at Emory University in Atlanta reported that injecting a ratlike animal called a vole with a single gene turned promiscuous males into stay-at-home dads - by activating precisely the same area of the brain where researchers in the new study found increased activity over time.

"This is very suggestive of attachment processes taking place," Dr. Brown said. "You can almost imagine a time where instead of going to Match.com you could have a test to find out whether you're an attachment type or not."

One reason new love is so heart-stopping is the possibility, the ever-present fear, that the feeling may not be entirely requited, that the dream could suddenly end. In a follow-up experiment, Dr. Fisher, Dr. Aron and Dr. Brown have carried out brain scans on 17 other young men and women who recently were dumped by their lovers. As in the new love study, the researchers compared two sets of images, one taken when the participants were looking at a photo of a friend, the other when looking at a picture of their ex.

Although they are still sorting through the images, the investigators have noticed one preliminary finding: increased activation in an area of the brain related to the region associated with passionate love. "It seems to suggest what the psychological literature, poetry and people have long noticed: that being dumped actually does heighten romantic love, a phenomenon I call frustration-attraction," Dr. Fisher said in an e-mail message.

One volunteer in the study was Suzanna Katz, 22, of New York, who suffered through a breakup with her boyfriend three years ago. Ms. Katz said she became hyperactive to distract herself after the split, but said she also had moments of almost physical withdrawal, as if weaning herself from a drug.

"It had little to do with him, but more with the fact that there was something there, inside myself, a hope, a knowledge that there's someone out there for you, and that you're capable of feeling this way, and suddenly I felt like that was being lost," she said in an interview.

And no wonder. In a series of studies, researchers have found that, among other processes, new love involves psychologically internalizing a lover, absorbing elements of the other person's opinions, hobbies, expressions, character, as well as sharing one's own. "The expansion of the self happens very rapidly, it's one of the most exhilarating experiences there is, and short of threatening our survival it is one thing that most motivates us," said Dr. Aron, of SUNY, a co-author of the study. To lose all that, all at once, while still in love, plays havoc with the emotional, cognitive and deeper reward-driven areas of the brain. But the heightened activity in these areas inevitably settles down. And the circuits in the brain related to passion remain intact, the researchers say - intact and capable in time of flaring to life with someone new.