

# Lovestruck

## Can scientists ferret out the biochemical roots of our most powerful emotion?

by [Deborah Rudacille](#)

From Shakespeare to Beyoncé, the great poets of the West have often compared romantic love to insanity. "My thoughts and my discourse as madmen's are," Shakespeare wrote in his sonnets. Beyoncé was more succinct: "Your love's got me looking so crazy right now."

Those who think that our tendency to equate romance with mental illness is a culturally specific quirk should think again, says biological anthropologist Helen Fisher. "When you read world poetry, the love poems are just about all alike," she says. Human beings suffered the same symptoms in 6th century Persia and 18th century England as they do today in Jakarta or New Jersey—sleeplessness coupled with intense energy, loss of appetite, obsessive thinking, violent mood swings. It is a loss of control so disorienting and overwhelming that it feels like madness.

The reason is simple, Fisher says. "Romantic love is a *drive*, as powerful as hunger and thirst and the will to live." Unlike simple emotions, which tend to be fleeting, "drives come from a very primitive part of the brain associated with craving," she says, and the symptoms of romantic love are created by the same brain chemicals active in the same brain regions as those involved in addiction. She has pictures of the brain in love to prove it.

Since 1996, Fisher and colleagues at Rutgers University have scanned the brains of college students who have recently fallen in love. Functional magnetic resonance imaging (fMRI) provides a visual representation of biochemical activity in the ten million or so neurons in the human brain. Different parts of the brain serve different functions, and each region produces, stores, and distributes neurotransmitters of different types that zip from neuron to neuron across tiny gaps called synapses. The various networks created by these biochemical interactions create thought, memory, sensations, motivations—in short, all that makes us more than inert hunks of flesh. Increased neural activity requires oxygen, increasing blood flow to the targeted region; it's this "hemodynamic effect" that researchers track on the scans.

The brains of Fisher's lovestruck subjects showed increased activity in two major areas. The most surprising was the caudate nucleus, a large C-shaped region deep in the center of the brain, part of what is commonly called "the reptilian brain" because of its evolutionary history. The caudate is known to be important in memory and learning, and it glowed bright yellow and orange whenever Fisher's subjects gazed at a photograph of their beloved. The more passionately these individuals professed their love in a questionnaire they filled out prior to the brain scan (thus scoring higher on the Passionate Love Scale), the more activity the researchers noticed in the caudate.

The magnetic resonance imaging also revealed significant activity in the ventral tegmental area (VTA), a small grape-like structure that manufactures large numbers of dopamine-making cells. Dopamine is a neurotransmitter that creates energy, focused attention, concentration, and feelings of elation. Pleasurable activities like eating and sex increase the production of dopamine, as does the anticipation of any kind of reward. A good number of the dopamine-drenched cells produced in the VTA migrate to the caudate nucleus, where they become active players in the brain's reward/motivation system. Certain drugs—cocaine, amphetamines, and nicotine—also target the

VTA, spurring dopamine cell production.

The activation of this network in her subjects is what led Fisher to theorize that romantic love is not merely a heightened emotion or set of emotions but a drive—a neural state that energizes and directs behavior to satisfy a biological need, in this case bonding with a preferred mating partner. The drive to love is both distinct from, and far more powerful and persistent than, the sex drive, Fisher says. This is particularly true when love is unrequited. "If you want to go to bed with somebody and they say 'no, thank you,' you don't kill yourself," she points out. But a significant number of those rejected by their preferred love object do harm themselves and/or their would-be lovers. Abnormally high levels of dopamine activity have previously been linked to psychosis and schizophrenia. Moreover, the dopamine "high" is inevitably followed by a "low," which creates the withdrawal symptoms of rejected lovers, who will—like drug addicts craving a fix—seemingly run any risk to achieve the "reward" that will once again provide a dopamine boost. "You can really lose control," Fisher says. "Do stupid things, say stupid things. Go stupid places. Make stupid decisions." But people in love can also, she points out, "make brilliant decisions that they wouldn't have the courage to make otherwise."

Not everyone buys the notion that Fisher's research has definitively identified the biochemical basis of love. For one thing, fMRI isn't able to identify which neurotransmitters are creating the increased activity visible on the scans, according to Wayne Drevets, chief investigator among a group of scientists who use neuroimaging to study mood and anxiety disorders at the National Institute of Mental Health in Rockville. "It can say where hemodynamic activity changes," he points out, "but it cannot determine what neurotransmitter systems are involved." Then too, while the increased caudate response in Fisher's subjects is clear, lots of different types of mental activities have been shown to activate the caudate in brain mapping studies. "So while I would agree that systems that process reward and stress signals are likely to be involved in romantic love," Drevets says, "the fMRI data have limitations in their ability to prove this."

That said, other studies have replicated Fisher's results, notably a 2000 British study that showed similarly enhanced activity in the same brain regions among an older (ages 21 to 37) group of subjects who had just fallen passionately in love. Also, psychotherapists who treat both addicts and those suffering reversals of love agree that there is an eerie similarity between the feelings and behavior of people rejected in love and those in the grip of addiction.

Rejected lovers "are consumed, paralyzed, sometimes suicidal or homicidal," says therapist Jeff Rubin, who for more than two decades treated troubled individuals and feuding couples at his Cross Keys office. "It does correlate a lot with the end phase of addiction, when the person is realizing that they are in trouble, that they've hit a wall, and there is no future." If one accepts that much human behavior has a biochemical basis, the correlation between romantic love and addiction seems intuitively correct, though it will take more research to prove it.

Fisher, meanwhile, has moved on to a question that her previous studies left hanging: Why do our brains get turned on by one person but not another? Reams of data have shown that individuals tend to fall in love with people with similar socioeconomic profiles, and with the same general level of intelligence and education, she points out. "But when scientists look at personality types, they find no pattern at all to mate choice." She's not the only one interested in this puzzle—the online dating service Match.com is funding her research to determine if there is any way to establish a biochemical basis for attraction. Two and a half years into that quest, Fisher believes that she has some preliminary answers.

Genetics research and studies of people taking drugs that alter brain chemistry have shown that four chemical

messengers—dopamine, serotonin, estrogen, and testosterone—play an important role in mood and personality. "Estimates suggest that 50 percent of the variance in personality is chemical," Fisher says. "And there is a great deal of literature indicating a constellation of personality traits associated with high levels of various neurotransmitters and hormones." While each person is under the influence of all four of the chemical messengers she is studying, the ratio varies in each individual, creating certain distinct personality types, she says, and that has implications for mate choice. Partnering with the folks at Match.com, she set up a new dating site, Chemistry.com, featuring a questionnaire that seeks to determine whether the test-taker is an Explorer (high dopamine type), Builder (high serotonin type), Negotiator (high estrogen type), or a Director (high testosterone type). "Nobody is going to have all the traits associated with one style, but they do tend to appear together in a constellation," she says.

Every few weeks, Fisher evaluates the raw data from the Chemistry.com survey. The results have been illuminating with regard to "first attraction," she says. Explorers (novelty-seeking, risk-taking, impulsive, and creative) and Builders (calm, social, loyal, persistent) are male and female in nearly equal numbers and tend to choose partners "very much like themselves." On the other hand, Negotiators (altruistic, nurturing, highly verbal, passionate, and intuitive) and Directors (analytical, logical, rule-based, tough-minded, and competitive) in overwhelming numbers choose each other. Unlike the first two categories, there are a great many more female Negotiators and a great many more male Directors, Fisher says. "But what we're finding is that Negotiators go for Directors, whether they are male or female, and Directors go for Negotiators, whether they are male or female."

Bill Clinton, she points out, is a classic Negotiator, despite the fact that he is male. And Hillary? Well, even without seeing her test results it's a pretty good bet that she's a Director.

More than three million people have hit on the site so far and hundreds of thousands have taken the test, "so we're talking about huge numbers of subjects," Fisher says, far more than most studies of its kind. Her next step is to return to the lab to take blood, saliva, and urine samples from two hundred new subjects to ensure that the questionnaire accurately measures what it purports to measure—the individual's biochemistry as expressed by personality type. If the correlation pans out, Chemistry.com will likely bill itself as the first ever truly "scientific" dating service. "There are too many factors in romantic love to say that you can ever match anybody perfectly," Fisher admits. "But we are coming a lot farther in just being able to give people some choices in the ballpark."

For some romantics, this is just too much. They argue that quantifying attraction in this way is dehumanizing. "It really takes out the spiritual component of falling in love, which I find offensive," says psychotherapist Rubin. "But I can see why it is attractive to people who want to make dating more efficient. We're so into numbers now." With divorce rates being what they are, people want assurances that they are choosing wisely and that love will last, he says. But predicting the outcome of a love affair is a dicey business. "I ask every couple I see how they got together. With some it was love at first sight, which would relate to the chemistry angle, and with others love developed after friendship. But I don't see any evidence that one kind lasts any longer than another. It all seems pretty random to me."

Biochemists interested in that question often point to a second set of hormones shown to correlate to long-term attachment—vasopressin and oxytocin, the so-called "cuddle chemicals." During orgasm, levels of vasopressin rise dramatically in men just as oxytocin levels rise in women. Animal research has shown that vasopressin leads males to defend their space and jealously guard their mate from competitors. Similarly, oxytocin released during birth and breastfeeding promotes mothers' bonding with their newborns, as well as with sexual partners during intercourse. As the heady dopamine high of early romance gives way to the more mellow influence of these two

chemical messengers, jitteriness and craving give way to feelings of security, comfort, and calm—the hallmarks of long-term relationships.

No doubt many folks would rather believe that Cupid shoots an arrow into lovers' hearts than acknowledge that the highs and lows of romance are created by the same brain chemicals that compel people to dash out in the middle of the night to buy a pack of cigarettes. But Fisher maintains that just because you understand the biochemical basis of love doesn't mean you can't still enjoy the experience.

"Look, you can know every single ingredient in a chocolate cake," she says, "but when you sit down to eat it you still get the rush."

—*This is freelance writer Deborah Rudacille's first article for Urbanite.*