

HOW LITTLE WE KNOW.....OR DO WE?

THE PHYSIOLOGY OF ROMANTIC LOVE

BY

MARC PETTY CRUCIGER, M.D.

PRESENTED TO THE CHIT-CHAT CLUB
SAN FRANCISCO, CALIFORNIA

APRIL 2007

PREFACE

“How Little We Know”

How little we know, how much to discover
What chemical forces flow, from lover to lover.
How little we understand what touches off that tingle.
That sudden explosion when two tingles intermingle.
Who cares to define what chemistry this is?
Who cares with your lips on mine. How ignorant bliss is.
So long as you kiss me and the world around us shatters
How little it matters. How little we know.
How little we know. How little we know.

Composers: Carolyn Leigh and Phillip Springer

Singer: Frank Sinatra
Arranger: Nelson Riddle

Good evening gentlemen.

2400 years ago, on a night much like tonight, a group of distinguished Athenian gentlemen got together for a dinner and drinking party. Before the party had progressed very far, one of the guests suggested that the evening be spent on a subject not commonly discussed by them. Tonight, I suggest we do the same. Tonight, gentlemen, we shall speak of love.

But, gentlemen, of what kind of love shall we discuss? All of us know that there are many kinds of love. The Greeks had different words to describe them. *Agape* was used to describe unselfish, all-giving, spiritual love. *Storge* was used to mean natural affection like parental love. *Philia* was used to describe a non-sexual, brotherly love. But these are not the kinds of love I wish to discuss. Tonight I want our attention to turn to what the Greeks called *eros*. This is romantic love...the love that describes a passionate and erotic, all consuming desire, both physical and emotional, for a very specific partner. This is the kind of love that has obsessed men and women since Adam and Eve. It has inspired poets, writers, and musicians down through the ages and across all cultures.

To be specific, however, tonight I want to explore what really happens physiologically to us when we fall in love. Interestingly, there were attempts to understand the physiology of romantic love down through the ages. In the western intellectual world, Plato was the first to try but the baton was soon passed to the medical world where it would remain for the next 2000 years. Because of the scientific revolution in medicine, the subject was essentially abandoned by the early 20th century. But, within the past two decades, there has been a resurgence of interest and subsequent scientific research. And, as I shall argue this evening, the ancient scientific understanding of the physiology of romantic love showed a prescience that is simply astonishing with today's understanding. But in order to substantiate my hypothesis, I must first acquaint you with what the ancients believed happens when you fall in love.

The first attempt in the western philosophical tradition to understand the nature of love is found, of course, in Plato's two great Socratic dialogues: the Phaedrus and the Symposium. In the Phaedrus, Socrates tells us that love is a "sort of madness"(1) given to man as a "gift of the gods"(2). He continues by saying that when one is in love he is "touched by ... madness"(3). In the Symposium, Socrates tells the assembled gentlemen at the dinner party that he has learned that love is always "needy"(4). Plato writes again in the Phaedrus:

In this state of mingled pleasure and pain the sufferer is perplexed by the strangeness of his experience and struggles helplessly; in his frenzy he cannot sleep at night or remain still by day, but his longing drives him wherever he thinks he may see the possessor of beauty.(5)

All of us around this table will recall that, for Plato, *eros* is ultimately a bridge that leads the lover on a transcendental journey to an understanding of ultimate spiritual beauty. But let's make no mistake about it, gentlemen, Plato emphasizes that love is something that begins very viscerally...a psycho-physiologic human need or drive if you will, that leads to a sort of madness.

This concept of love being a state where one is out of control and exhibiting physical symptoms is articulated by one of the greatest love poets of the early Western tradition, Sappho. Gentlemen, let us listen to Sappho as she describes romantic love in the following fragment:

*For I only, briefly, need glance at you to
Find my voice has gone and my tongue is broken,
And a flame has stolen beneath my skin, my
Eyes can no longer
See, my ears are ringing, while drops of sweat run
Down my trembling body, and I've turned paler
Than a wisp of straw and it seems to me I'm
Not far off dying.(6)*

Burning skin? Eyes that do not see? Pallor? Ringing in the ears? Madness? Trembling? Inability to speak? It really seems as if Plato and Sappho are describing symptoms of some sort of disease? And, indeed, as Dr. Frank Tillis writes in his book, Love Sick: Love as a Mental Illness:

Love is...associated with a wide range of physical 'symptoms'. Lovers are often described as fevered, or pale and depleted—unable to sleep or eat...for as long as people have been writing about love, they have also been describing it as an illness.(7)

Paradoxically, although many of the symptoms of love do mimic those of an illness, there was a surprising lack of medical writing on the nature of love until we meet the great doctor of Roman antiquity, Galen. In his book, On Prognosis, Galen is called upon to cure Iustrus's wife of insomnia. Although the woman was not helpful in answering questions as to her medical problem, Galen noted that when the name of a dancer, Plyades, was mentioned in her presence, her "expression and complexion changed" (8) and her "pulse became extremely irregular." (9) The symptoms did not occur with the names of other dancers. Gentlemen, let us listen to Galen on perhaps the very first medical diagnosis of love in the Western tradition:

On the fourth evening, I kept very careful watch when it was announced that Plyades was dancing. And I noticed that the pulse was very much disturbed. Thus I found out that the woman was in love with Plyades, and by very careful watch on the succeeding days my discovery was confirmed. (10)

Galen was profoundly influenced by the ancient Greek model of disease that traditionally has been attributed to Hippocrates, the father of medicine. Hippocrates and his followers postulated that all disease was simply an imbalance of four bodily humours: yellow bile, black bile, blood and phlegm. (Figure 1) Using this scientific framework, Galen hypothesized that romantic love, because of its physical symptoms, could be understood physiologically using the Hippocratic humoral model. Galen jettisoned the Platonic model, hypothesizing that when one falls in love, the body's four humours become unbalanced causing the symptoms one sees in lovers in love. Dr. Tallis summarizes:

Galen was happy to follow the Hippocratic tradition...The symptoms of love were nothing to do with divine intervention. He proposed that the lovesick individual, under the influence of a strong passion, experiences a humoral (or chemical) imbalance, which in turn promotes the occurrence of physical symptoms. (11)

With the fall of the Roman empire and Europe's entry into the Dark Ages, subsequent scientific inquiry on romantic love was passed on to the intellectuals of the Arabic speaking world. As they rediscovered the classical writings of Hippocrates and Galen, Muslim physicians readily embraced the Greek paradigm for the understanding of disease. One of the greatest Arab physicians of the medieval period was Ibn Sina, originally from Iran. In his book, The Canon of Medicine, Ibn Sina (980-1037 CE) agreed with Galen. Ibn Sina writes

that the symptoms of love sickness are due to “the result of a chemical imbalance brought about by...obsessing about the loved one.” (12)

As Europe slowly emerged from the medieval period and rediscovered the classical tradition, the physiological understanding of romantic love being caused by an imbalance of the four basic body humours persisted. In Elizabethan England, there was even an attempt to understand why romantic love was more common in the young as compared to the aged using the humoural model. In the book, Not Wisely but Too Well: Shakespeare’s Love Tragedies, the author Franklin Dickey explains the Elizabethan theory as follows:

...in youth the sanguine humor, ...hot and moist, was at its peak; since love gained its mastery by heating the blood, the young, whose blood was hot, were amorous...the old on the other hand, whose temperament was usually dominated by cold and watery phlegm, (and) naturally were able to resist the heat of love more readily (than) could the young. In middle age... the blood was usually tempered with more of the cold humors, black bile... and phlegm. Love could not readily cause...excessive heat....(13)

As we all know at this table, from the middle of the 16th century through the late 19th century, European scientists began to chip away at the ancient Greek humoural model of understanding disease. New findings in anatomy by Vesalius as well as Harvey’s discovery of the circulation of the blood were like battering rams on the established theory.

(14) Thomas Willis’s book, The Anatomy of the Brain in 1664, also served to undermine the old foundation because he argued that “psychological problems previously attributed to either supernatural or humoural causes were, in fact, the result of neurological abnormalities.” (15) In the 1800’s when germs were shown to be the cause of many diseases, the old humoural system of understanding disease essentially crumbled. Preoccupied with understanding and treating physical disease, the world of emotions was relegated to a new medical discipline called psychiatry.

Freud, psychiatry’s earliest and most prolific theorist, argued that the sexual drive was one of the most basic human motivators. He termed it Eros or life drive. But for Freud, human romantic love was all about sex. As Dr. Tallis points out:

It is now widely accepted that Freud had little to say about love, largely because of his preoccupation with sex. In Freud’s scheme, love tends to be viewed as a secondary...by-product of frustrated libidinous urges.(16)

Because of Freud’s huge influence, psychiatry concerned itself very little with the phenomenon of romantic love. Psychiatry’s cousin, psychology, also did the same. In a 1958 presidential address to the American Psychological Association, its president, Dr. Harlow stated the following:

So far as love or affection is concerned, psychologists have failed in their mission. The little we know about love does not transcend simple observation, and the little we write about it has been better written by poets and novelists.(17)

Yes, gentlemen, as mentioned at the beginning of this paper, by the mid 20th century there was no real physiological understanding of romantic love because the modern scientific world had simply decided to ignore it. 2000 years of cogitation had brought us back to our writers, poets and musicians. Perhaps, Dr. Harlow should have asked Sinatra to summarize the crux of his address by singing the song “How Little We Know” at that meeting in 1958.

However a nearly contemporaneous discovery was made that had profound effects in all fields of medicine. That discovery was the elucidation of the structure of DNA by Watson and Crick, and, with it, a modern renaissance in basic biological and medical research was begun. The new field most germane to our discussion tonight is that of neuroscience that developed using the tools from biochemistry, molecular biology, and physics. This new discipline seeks to understand the chemical and dynamic workings of the brain. Bioassays of neurotransmitters and new methods of imaging the brain, both in its static state and in its functional state, developed so, that within the past twenty years, the tools were finally in place to allow researchers to take a new and serious look at the physiology of that most human subject, romantic love.

Now, gentlemen, I want to share with you what the neuroscientists have discovered recently about the physiology of love. And, as I mentioned in the beginning of this paper, I believe it can be argued that the ancient physiological understanding of what happens when one falls in love is extremely close to the new modern understanding, namely that love is a human drive or need caused by an imbalance, not of humours, but of hormones and neurotransmitters that work in very specific parts of the brain. Let us take a look at the findings of this new research.

LUST, ROMANTIC LOVE, and LONG TERM ATTACHEMENT

Helen Fisher, in her book, Why We Love: the Nature and Chemistry of Romantic Love, argues that love can best be understood physiologically if it is broken down into three stages or phases of behavior: (1)**Lust**, (2) **Romantic love**, and (3) **Long Term Attachment**. As all of us at this table know, these phases are not mutually exclusive. For example, you can have a long term attachment with your spouse but still experience lust for another person. Although I have chosen the area of romantic love for tonight’s discussion, for completeness sake, let us look at all three individually.

I. LUST PHASE

The first stage is **LUST**. This is the primordial drive for sex and is essentially driven by levels of the hormone testosterone. Both genders have testosterone, males, obviously, have more of the hormone. As testosterone levels increase, sexual desire increases and vice versa. Male libido tends to peak in the 20’s and decline during middle and old age. Women’s libido, although not as high as men’s, does not statistically decline in middle age because as estrogen levels diminish, it unmasks the latent testosterone hormones.

(18) Lust does not seek a mate but a physical encounter.

II. ROMANTIC LOVE PHASE

ROMANTIC LOVE is the phase of love that Plato called “a madness”. It makes us giddy and gives us high energy and causes obsessive behavior. The current research has shown that individuals in the stage of romantic love have unusually high levels of several chemicals. They are (1) *phenylethylamine*, (2) *dopamine*, and (3) *norepinephrine*. What do each of these chemicals do to us? In short, they produce in us the symptoms observed and experienced in those who are madly and passionately in love. Gentlemen, now let’s briefly look at each of these chemicals one at a time that are associated with romantic love.

Phenylethylamine, or PEA for short, is often referred to in the lay press as the “love molecule.” It is essentially a natural form of amphetamine that our body produces. The molecule is thought to speed up the flow of information between nerve cells. Writers of romantic love often describe lovers as being shaky, prone to insomnia, as well as having increased energy and poor appetite. Increased respiration and heart rate are also common when one is near the one the lover desires. As Elvis Presley sang, when one is in love, one really is “all shook up.” This physiological state is caused by high levels of PEA. Interestingly, one sees similar symptoms in people who are high on amphetamines. High levels of the chemical PEA have been well documented in people who are in the initial throws of the romantic infatuation phase of love. But, PEA levels do tend to diminish over several years after one “falls in love”. (19)

The second and most important chemical that researchers have found elevated in romantic love is dopamine. It is a member of the chemical family that is the precursor to epinephrine, often called adrenaline by laymen. In the brain, dopamine acts as a neurotransmitter. It is also a neuro-hormone released in the part of the brain called the hypothalamus. Dopamine is important in allowing the body to move. A shortage of dopamine causes Parkinson’s disease. But dopamine also, as Dr. Crenshaw states, “...mobilizes you to recognize, seek and pursue pleasure.” (20) The new research on love has shown that dopamine is elevated in those smitten with love. In addition, dopamine stimulates sexual desire by raising testosterone levels. For that reason, Dr. Fisher refers to dopamine as the “liquor of romance.” (21) Dr. Crenshaw elaborates further:

Dopamine takes you on an emotional high...it is especially desirable and addictive... (it) is the common denominator in most human addictions from drug abuse to hypersexuality... (22)

In short, the “high of love” is physiologically very similar to the high of drugs such as amphetamines and cocaine.

Closely related to dopamine is the third romantic love chemical called norepinephrine also a form of adrenaline. It is produced in the adrenal glands. It is also a neurotransmitter in the brain. Like PEA and dopamine, norepinephrine also increases testosterone levels. This chemical is a stimulant and lower brain levels of it seem to be

correlated with depression. We all know, gentlemen, smitten lovers have high energy levels and are exhilarated. Just recall Oscar Hammerstein's lyrics in the song "Hello Young Lovers":

*I know how it feels to have wings on your heels
and to fly down the street in a trance,
You fly down the street in the chance that you meet
and you meet, not really by chance.*

This sensation of "wings on your heels" may be due to norepinephrine's stimulation of the sympathetic nervous system. As Dr. Fisher states, "...increasing levels of this simulant generally produce exhilaration, excessive energy, sleeplessness, and loss of appetite—some of the basic characteristics of romantic love." (23)

As you can see, gentlemen, the new research on the physiology of love actually supports the Hippocratic model, namely that when one is in love, there is a change or imbalance in chemical levels, specifically in the brain. Once one finally finds that special someone and falls in love, the levels of phenylethylamine, dopamine, and norepinephrine increase as compared to the levels in those not in the throws of romantic love. All of these three chemicals have the further hormonal effect of raising testosterone levels thereby increasing libido. As all these "love potion juices" flow, they cause the symptoms and behavior of those who are smitten with love.

Research has gone even further. Using the new technology of functional MRI, neuroscientists are able to visualize which parts of the brain are active at any given time. And the critical question that needed to be answered is the following: Are the areas of the brain associated with the dopamine centers more active in those individuals in love than those who are not in love? The short answer is a resounding "yes"!

In the year 2000, two distinguished British neuroscientists, Bartels and Zeki, performed functional MRIs on 17 students who reported being madly in love. The study compared the MRIs when the lovers were shown pictures of the faces of their lovers in contrast to the MRIs taken when they were shown faces of just their friends. The results showed that when the subjects were shown their beloved's face, the area of the brain called the caudate nucleus "lit up". (Figure 2) And, gentlemen, the caudate nucleus is the area where 80% of the brains receptors sites for the neurotransmitter dopamine reside. Of note, it is also the area of the brain that is involved with cocaine and drug induced euphoria. The researchers concluded something that all lovers know, namely, that there is "...a close neural link between romantic love and euphoric states."(24)

Importantly, the study also showed that the areas of the brain activated in romantic love are very distinct from those areas of the brain that are activated with sexual arousal (25) correlating nicely with Dr. Fisher's three divisions of love, namely, LUST, ROMANTIC LOVE and LONG TERM ATTACHMENT. Bartels and Zeki conclude their paper in poetic prose most unusual in scientific papers:

By showing that a unique set of interconnected areas become active when humans view the face of someone who elicits a unique and characteristic set of emotions, we have shown that underlying one of the richest experiences of mankind is a functionally specialized system of the brain. It is perhaps surprising that so complex and overwhelming a sentiment should correlate differentially with activity in such restricted regions of the brain... (26)

Further functional MRI studies corroborating their findings have been done by Drs. Fisher, Brown and Aron. They also showed that the caudate nucleus was highly active when those in love viewed the pictures of their lovers. In the words of Dr. Fisher:

...our most important finding was activity in the caudate nucleus...the more passionate...the more active (the) caudate.(27)

Along with activity in the caudate nucleus, Fisher's research found high activity in another area of the brain rich in dopamine producing cells called the ventral tegmental area or VTA for short. (Figure 2) (28). The most important point is that the areas of the brain most active in ROMANTIC LOVE are the dopamine centers. However, since the caudate nucleus is so active in lovers, Fisher refers to it as "the furnace of romantic love." (29)

III. LONG TERM ATTACHMENT PHASE

Finally, gentlemen, a few brief comments about the third phase of love called LONG TERM ATTACHMENT. Does it also have an imbalance of chemicals at play and are there specific areas of the brain activated with it? The answer to both is "yes." Recent research has shown that two neurohormones, oxytocin and vasopressin, are elevated in those who have been bonded in love for many years. Oxytocin is released in women during childbirth and lactation and research has shown that this chemical helps the mother to bond emotionally to her newborn. And vasopressin has also been shown to be critical in long term bonding in rodents and primates. (30) During intercourse, these chemicals are released in both genders with breast and genital stimulation as well as with orgasm. (31) Oxytocin has also been shown to be released even when humans hold hands or "snuggle," resulting in its referral in the lay press as the "cuddle hormone". In short, with each erotic moment with one's beloved, nature is bonding the couple tighter and tighter by elevating the oxytocin and vasopressin levels. Wanderlust, by contrast, is suppressed because testosterone levels are driven down when oxytocin and vasopressin levels rise. (32)

The study by Bartels and Zeki that I mentioned earlier, showed that the longer the lovers were in love, other parts of the brain, in addition to the caudate nucleus, become active (namely the anterior cingulate gyrus and the insular cortex). And in an additional study in 2003, they found that a particular type of long term attachment kind of love, namely maternal love, activated areas of the brain that are rich in receptors for oxytocin and vasopressin (periaqueductal central gray matter or PAG). (33)

CONCLUSION

In conclusion, it seems that current scientific research on the physiology of romantic love shows that the very primitive areas of the brain correlated with reward and pleasure, are the same as those activated when we are smitten with love. And, indeed gentlemen, does this not make sense? If we as a species are to continue, we need very primitive drives and rewards to make this happen. Propagation of the species is more than just about sex. As very special mammals, our young are helpless and need to be nurtured and protected for several years. This nurturing and protective environment is best accomplished by a tightly bonded male and female pair. And, gentlemen, **the bond that cements the couple tightly is romantic love and its glue is, primarily, dopamine.**

Sadly, however, that high energy, besotted, and giddy phase of romantic love...that “divine madness”, as Plato called it, seems to last, at most 2 to 4 years. During that time frame, the chemicals of love, PEA, norepinephrine and dopamine are at high levels. Those chemicals in turn elevate testosterone driving the besotted couple to mate. This time frame is long enough, however, for the couple in love to produce a child and rear the child to at least the toddler stage at which point its survival is less precarious and less dependent on constant parental attention. Yet, if the oxytocin and vasopressin levels are increased enough during the romantic love phase, long term attachment will develop and the couple will remain together to continue to rear the child.

Well, as you can see gentlemen, the present physiological understanding of romantic love has definitely been enhanced by the new medical technology. Commenting on the functional MRI studies by the Fisher team, Dr. Hans Breiter, director of Massachusetts General Hospital’s Motivation and Emotion Neuroscience Collaboration, stated, “I distrust about 95% 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.” (34) I must emphasize, however, that the information that I have shared with you tonight, surely will not be the final word. To quote Bartels and Zeki, “There is no doubt that future studies will address these points more explicitly.” (35) However, I believe a case can be made that, as it stands today, Plato and Hippocrates were correct: **Love is a human drive or a need reflected by an imbalance of chemicals in the body.**

But, gentlemen, tonight, when you return to your lover, and if she asks you, “Why do you love me?” what will you say? Will you say, “Darling, it is because when I first looked at you, you raised my testosterone, PEA, dopamine and norepinephrine levels in my brain and with every touch my oxytocin levels increased so much that I cannot stand to live my life without you.” I think not. I think that you, as I, will always turn to our artists for the perfect words. When asked, “why do I love you?” I shall reply tonight..... because “you are my north, my south, my east and my west.”(36)... because “you make me smile with my heart”(37)... because “Night and day you are the one, only you beneath the moon and under the sun.”....(38) because “It’s delightful, it’s delicious, it’s de-lovely.” (39)

TYPES OF LOVE

Lust

^ Testosterone

^Libido

Romantic Love

^Phenylethylamine
^ Dopamine
^ Norepinephrine
v Serotonin

^Obsessive thoughts
^Energy
v Appetite

Long Term Attachment

^Vasopressin
^Oxytocin

^Bonding
^Tenderness

FUNCTIONAL MRI STUDIES

Lust (Refs #1&2)

Sub Cortical Regions

Left Caudate Nucleus
Right globus pallidus

Cortical Regions

Right Insula
(Deactivations noted in
Posterior CingulateCortex
and Right Hemisphere)

Romantic Love (Refs #3&4)

Sub Cortical Regions

Caudate Nucleus
Ventral Tegmental Area
Putamen

Cortical Regions

Anterior CingulateCortex Left
Middle Insula

Long Term Attachment (Refs #5)

Sub Cortical Regions

Periaqueductal Central
Gray Matter (PAG)

Cortical Regions

Lateral orbito-frontal cortex

REFERENCES TO THE FUNCTIONAL MRI DATA

1. Stoleru, S, et al. Arch Sex Behav 28, 1-21 (1999).
2. Rauch SL, et al. Psychiatry Res 91, 1-10 (1999).
3. Bartels A, Zeki S. NeuroReport 11 #17 3829-3824 (2000)
4. Fisher, H. Why We Love: The Nature and Chemistry of Romantic Love. New York. Henry Holt and Company. 2004.
5. Bartels A, Zeki S. NeuroImage 21, 1156-1166 (2004).

ENDNOTES

1. Hamilton, Edith and Cairns, Huntington. 1961. Plato: The Collected Dialogues. Princeton University Press. P. 492.
2. Ibid., p.492.
3. Ibid., p. 496.
4. Ibid., p. 555.
5. Tallis PhD, Frank. 2004. Love Sick, Love as a Mental Illness. New York: Avalon Publishing Group Inc. p. 10.
6. Chandler, Robert. 1998. Sappho. London: Everyman's Paperbacks. p. 10.
7. Tallis PhD, Frank. Ibid., p. 2.
8. Ibid., p. 12.
9. Ibid., p. 13.
10. Ibid., p. 13.
11. Ibid., p. 13.
12. Ibid., p. 16.
13. Dickey, Franklin M. 1957. Not Wisely but Too Well: Shakespeare's Love Tragedies. San Marino: Huntington Library. P. 30.
14. Loudon, Irvine. 1997. Western Medicine: An Illustrated History. Oxford: Oxford University Press. Pgs..78-79.
15. Tallis PhD, Frank. Ibid. P32.
16. Ibid., p. 36.
17. Ibid., p. 39.
18. Fisher, Helen. 2004. Why We Love: The Nature and Chemistry of Romantic Love. New York: Henry Holt and Company. Pgs 81-82.
19. Crenshaw. Theresa L. 1997. The Alchemy of Love and Lust: How our Sex Hormones Influence Our Relationships. New York: Simon and Shuster. P. 55-62.
20. Crenshaw, Theresa. Ibid. P. 134.
21. Fisher, Helen. Ibid. P. 83.
22. Crenshaw, Theresa. Ibid. P. 134.
23. Fisher, Helen. Ibid. P 53.
24. Bartels, A. and S. Zeki. The neural basis of romantic love. Neuroreport. (2000) 11#17:3829-3834. p. 3833.
25. Ibid. p. 3833.
26. Ibid., p. 3833.
27. Fisher, Helen. Ibid. P. 69.
28. Ibid., p. 71.

29. Ibid., p. 72.
30. Bartels, A. and S. Zeki. The neural correlates of maternal and romantic love. NeuroImage (2004) 21. P. 1155.
31. Fisher, Helen. Ibid., p. 89.
32. Ibid., p. 90.
33. Bartels, A. and S. Zeki. Ibid. P. 1156-1166.
34. Carey, Benedict. "Watching New Love as It Sears the Brain". New York Times. May 31, 2005.