

Special Interest

A Journey through the Labyrinths of Love



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HUMAN BEINGS HAVE AN INNATE AND UNIVERSAL CAPACITY FOR LOVE. THIS PAPER WILL EXPLORE THE MECHANISTIC DEVELOPMENT OF BOTH SHORT AND LONG-TERM RELATIONSHIPS, THEIR MEDIATION BY THE MOTIVATION AND REWARD-ORIENTED MESOLIMBIC SYSTEM AND THE IMPORTANT ROLES PLAYED BY SEVERAL NEUROTRANSMITTERS. THESE SYSTEMS SHED LIGHT ON HOW CHANGES IN COMMITMENT MAY BE MEDIATED BY HORMONES THAT PROMOTE ATTACHMENT AND DAMPEN ROMANTIC PASSION. SUMMARILY, LOVE AND ADDICTION ARE SHOWN TO BE SIMILAR; BOTH ARE CHARACTERIZED BY CRAVINGS, LOSS OF CONTROL AND WITHDRAWAL.

Love poetry was first written in ancient Sumeria four thousand years ago in cuneiform on a small piece of clay (Fisher, 2004). In a study conducted on 166 different cultures worldwide, 90 percent of them showed evidence of romantic love (Fisher, 2004). This article will delve into the human capacity for love, its neurochemistry, the different types and how love changes over time. It will touch on age and its relation to love intensity, as well as the negative aspects of love. It is important to note, however, that the mechanisms of love remain largely a mystery to researchers, and no theories pertaining to the subject have been proven to be conclusive (Levitt, 2006).

INNATE CAPACITY

The capacity to love intensely is thought to be an innate human quality. One prominent researcher in the field, Helen Fisher, postulates that the capacity to love is a product of our large and complex prefrontal cortex (Fisher, 2004). Certain regions of the brain, such as the amygdala, hippocampus and caudate nucleus, are thought to be responsible for our capacity to love (Fisher, 2004, 150). These regions enable us to think in many different contexts related to our loved ones, to remember them in great detail, and to attach strong emotions to these thoughts and memories.

LOVE AS NEUROCHEMISTRY

The main system involved in the emotion of love is the pleasure pathway, which consists of dopamine pathways in the mesolimbic system. Studies using functional magnetic resonance imaging (fMRI) have demonstrated increased activity

in the ventral tegmental area (VTA) and the caudate nucleus of individuals when they are shown a photo of someone they love. The caudate nucleus helps maintain the intensity of love by heightening anticipation, motivation, and planning for a particular reward. The more passionately a subject feels towards their lover, the more active their caudate nucleus appears on the fMRI (Fisher, Aron, & Brown, 2005). The dopamine system promotes feelings of pleasure, motivation, and 'general arousal'. The glutamate neurotransmitter is involved in memory and learning pathways. Along with dopamine, glutamate may also trigger a memory of the loved one in response to environmental cues (Hyman, 2005). The neurotransmitter norepinephrine is associated with sentiments of love, including energy, alertness,

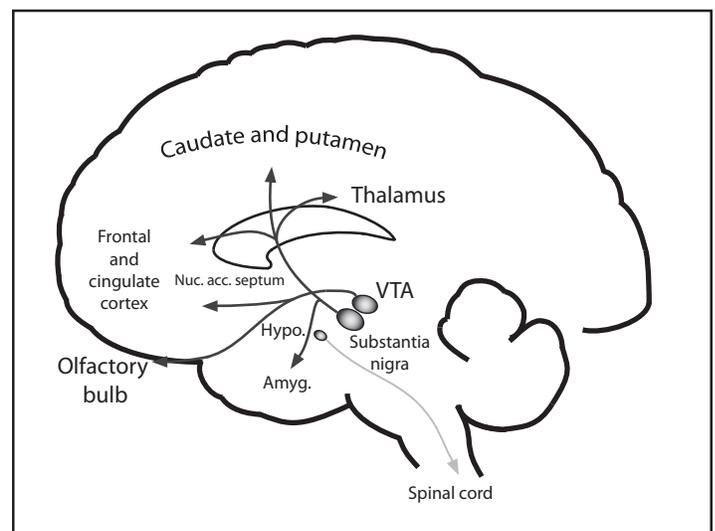


Figure 1 The mesolimbic dopamine system is made up of the ventral tegmental area (VTA) and the substantia nigra, which send dopamine neuron axon projections to various sites, including the nucleus accumbens, prefrontal cortex, and caudate nucleus and putamen (Gardner & Pagani, 2003; Kolb & Whishaw, 2006, p.227).

inability to sleep, and loss of appetite (Fisher, Aron, & Brown, 2006).

DIFFERENT TYPES OF LOVE AND CHANGES OVER TIME

The triangular theory of love postulates that love has three dimensions: intimacy, passion, and commitment (Ackler et al., 1992). Intimacy is the feeling of connection between lovers, while passion is related to motivational and arousal behaviours, including physical attraction, sexual craving, and romance. Commitment is the premeditated choice to maintain a long term partnership with a mate (Fisher, 2004). These dimensions of love change over time; intimacy and passion decrease while commitment increases (Ackler et al., 1992). Romantic passion typically wanes over time from an obsessional, high energy "kind of sickness" to a calmer, "companionate love". It is not known for sure how the brain dampens romantic love. It may produce less dopamine and norepinephrine, or their receptor sites may become desensitized. Other hormones such as oxytocin may inhibit these chemicals (Fisher, 2004). Oxytocin and vasopressin, produced in the hypothalamus and gonads, are partly responsible for feelings of attachment (Carter, 1998). For example, in monogamous prairie voles, suppressing vasopressin causes promiscuity while enhancing it increases possessiveness (Wang, Ferris, & De Vries, 1994). Oxytocin fosters long-term attachment between males and females (Carter, 1998).

There is a complex relationship between the romantic neurotransmitters and the attachment hormones. In certain situations, dopamine and norepinephrine can cause the release of oxytocin and vasopressin (Esch & Stefano, 2005). However, oxytocin can

inhibit dopamine and norepinephrine activity, thus 'quelling the chemistry of romance' (Fisher, 2004). Melatonin and arginine-vasotocin, the two major pineal hormones, may inhibit the effects of romantic love and infatuation in the brain by dampening dopamine activity and inhibiting activity in the caudate nucleus (Shoja et al., 2007).

Nature may have programmed our brains to inhibit feelings of romantic passion over time. Romantic love is stressful and involves a large expenditure of energy, and thus would be maladaptive if sustained over long periods (Esch & Stefano, 2005). Romantic love likely evolved to drive the sexes to seek out and mate with each other and remain faithful long enough

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to bear a child. However, In order to raise the child, parents need feelings of attachment rather than intense romantic passion (Fisher, 2004).

Two regions in the brain, the anterior cingulate cortex and the insular cortex, are more active in long-time lovers than in new lovers (Fisher et al., 2005). Emotions, attention, and memory interact in the anterior cingulate region. It is possible that over time, the brain consolidates and integrates emotional memories and thoughts involving love (Fisher, 2004).

IMPACT OF AGE ON LOVE

While love changes over time, it does not appear to correlate with age. One survey found that forty-five year-olds

reported the same level of passion for their lovers as subjects under the age of twenty-five (Fisher, 2004). A cross-generational study of 255 subjects had similar findings (Wang & Nguyen, 1995).

"LOVE SICKNESS"

Love is not a singular emotion but a motivational system causing a range of emotions, not all of which are pleasant (Fisher et al., 2005). Separation anxiety occurs not only in small children but between lovers as well, causing the release of stress hormones such as cortisol and corticosterone (Fisher, 2004). For example, separation of female and male prairie voles increases corticosterone levels. However, when the partners are reunited, corticosterone levels drop to levels below baseline (Carter, 1998). Love is associated with other negative emotions, such as 'anxious preoccupied attachment' (Bartholomew & Horowitz, 1991). This occurs in an individual who is over-involved in the relationship and is dependent on another for his or her emotional well-being.

LOVE AND ADDICTION

There are strong similarities between love and addiction (Dupont, 1998). Romantic love produces a euphoric high that is characteristic of many illicit drugs. Like addiction, love is associated with craving and obsession. Passion is often very difficult to control and leads to impaired decision-making, similar to the effects of drug addiction (Fisher, 2004).

Love and addiction both share similar neurochemical pathways. Both are associated with the mesolimbic reward and motivation system, which is mediated largely by dopamine (Esch & Stefano, 2005). One study looked at

fMRI scans of subjects in love compared to subjects who had just taken opioids or cocaine. Many of the same brain regions were active, including the anterior cingulate cortex, the caudate nucleus and putamen, as well as the insular cortex (Bartels & Zeki, 2000).

People in love also exhibit three common stages of addiction: craving, withdrawal and relapse (Fisher, 2004). For instance, as a relationship intensifies, they usually crave more and more of the “love drug” (Fisher, 2004, p.183). When separated from their lovers for any length of time, they often crave renewal of contact. Upon the termination of a particular relationship, the participants often show signs of withdrawal, such as anxiety, insomnia, fluctuations of appetite, depression, anxiety, and progressive irritability. The craving may persist long after the relationship has ended, sometimes triggered by environmental cues that are reminders of their lost lover, such as a song or a common acquaintance. These cue-triggered cravings are present in a similar fashion in those created by addictive drugs (Hyman, 2005).

However, differences between love and addiction remain (Esch & Stefano, 2005). Natural pleasure producing activities, such as eating or sex, have feedback loops that can inhibit motivational behaviour or even activate aversion. After eating, it takes time for appetite to return. These mechanisms do not always work for drugs such as cocaine (Esch & Stefano, 2005).

CONCLUSION

The mesolimbic pleasure pathway is the main system believed to control love. This “love pathway” is associated with many different types of neurotransmitters, including dopamine, glutamate, and norepinephrine. The triangular theory of love describes intimacy, passion, commitment, and the different components of love. Love may be a form of subtle addiction. Addicts and lovers exhibit similar behaviour, and lovers go through two stages related to addiction - withdrawal and relapse. Conversely, some drugs stimulate cravings that do not always cease immediately after taking the drug. 

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