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Love and Addiction

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I could begin this article by catching your attention with vivid, love-associated sensory details. I could describe the palm sweating nervousness of one's first kiss or I could describe the earth-shattering heartbreak when your first crush likes someone else, but these details would do just that: catch your attention. These are details people unsurprisingly find interesting. In order to believe the details in this article, I need to make it clear that love is mostly controlled by responses in the brain rather than cupid throwing arrows.

Research on prairie voles has shown significant support in the idea that love is dictated by neurotransmitters and the reward center of the brain. There are two species of prairie voles used in this research that are completely identical aside from one detail: one species is monogamous while the other species is polygamous. The monogamous species, as compared to the polygamous species, has been found to have many receptors for love associated neurotransmitters in the reward structures of the brain—structures that are activated by the same rewarding effects as things like food and drugs. It has also been found that if the polygamous species is injected with vasopressin (a hormone associated with communication and sexuality) and oxytocin (known as the bonding hormone), then those polygamous voles become monogamous and pair bond. The degree of this pair bonding is determined by the amount of hormone the vole is given.¹

Monogamy and love in humans has also been linked to oxytocin and vasopressin as well as the reward structures of the brain. Because love and pair bonding can be mostly demonstrated neurologically in the prairie voles, then one can believe that, given that humans are similar, you can learn a lot about love and heartbreak by assessing what happens in the brain during these stages in life.

Backing up to the palm sweating and the jitters of falling in love; that's where the brain changes first start. First of all the concentration of oxytocin and vasopressin increases as already described. At the same time, dopamine is secreted by cell bodies in the hypothalamus (a portion of the forebrain), and this dopamine floods the brain.² Dopamine is considered a feel good neurotransmitter, and this flooding causes a feeling of

euphoria in the lovebirds. This euphoria is similar to the euphoria cocaine addicts feel when they have a high, and love and cocaine surprisingly tend to have similar mechanisms. Where love floods the brain with dopamine, cocaine blocks DAT. DAT is a transporter that takes up dopamine, which leaves the neurotransmitter in excess in the extracellular space of the brain just as love does.¹⁴ Similarly, nicotine creates a surge of dopamine that makes the individual feel satisfied and even euphoric.³ Just as cocaine and nicotine addiction potential, does this mean love could, too?

Surges of dopamine put the drug users into a "goal-oriented motivational state" where the person's next goal is to get their next hit.³ Love creates the same reward seeking state: people in love crave being with their partners much like junkies crave their drug because their partner's presence causes a high level of emotional reward.⁴

However, it is a particular type of love that creates this goal-oriented motivational state. Some research has been done on the difference between selfless love and romantic love. Where selfless love is boundless, romantic love has been shown to have the same addictive effects as drugs—particularly cocaine. Romantic love, like a drug leaves you wanting more; as Judson Brewer, an associate professor at UMass Medical School, states, "You want that next date, you want that next tweet, you want that next text".⁵ Humans are clearly addicted to immediate reward, and falling in love is no exception. People in love are addicted to love. People in love seem to act like drug addicts: the obsessive-compulsive behavior, the need for another 'hit' of their significant other.

Another change in the brain that occurs as you enter a new romantic endeavor is a massive serotonin depletion.⁶ Serotonin is a neurotransmitter that reduces anxiety and gives one a sense of being in control. Once serotonin is depleted, an individual will develop a loss of control and begin displaying obsessive-compulsive behavior particularly toward their relationship.⁶ Interestingly, the drug MDMA (ecstasy) produces an acute and huge release of serotonin that breaks down tissue and, like love, results in serotonin depletion.⁷

Love also displays the same effects as cocaine's medici-



"People in love are addicted to love."

nal uses. Cocaine, unknown to many, can be used as a local anesthetic because it blocks sodium channels necessary for a cell to fire, so cocaine can be used to prevent pain.⁸ By using a heated probe and an fMRI for imaging, studies have shown that love can lessen physical pain by inducing activation in the same areas of the brain as cocaine.³ These are the same brain areas activated when administering other painkillers also, such as morphine.³

Not only are the neurotransmitter mechanisms and brain activation between drug use and love extremely similar, but the mechanisms between drug addiction or craving and love also coincide. When an individual is shown pictures of their love interest, the ventral tegmental area, the nucleus accumbens, and the caudate nucleus are heavily activated.⁹ These areas of the brain form a pathway that is associated with reward and craving.¹⁵ It is prevalent in not only love and food cravings, but also, unsurprisingly, drug addiction.¹⁵

The comparisons don't end there. Even after the relationship is over, lovebirds are left addicted and craving more. After heartbreak, it has been shown that the ventral tegmental area and the caudate nucleus—those same major brain structures in the addiction and reward pathway—are even more active than during the relationship, much like an early abstinent ex-drug user.⁹ These people are going through a craving stage similar to a drug-craving stage during a drug-users abstinence period, so their orbitofrontal cortex (a part of the brain that acts to prevent impulses and help decision making) also switches on in order to inhibit impulses and quiet the activity of the reward pathway.⁹

The anterior cingulate—a structure of the brain that is associated with experiencing physical pain—is also activated.¹⁰ This activation of structures involved in pain and addiction explains the common manic and irrational activity that comes after a breakup such as inappropriate amounts of texting the ex-lover, crying for hours, and/or stalking behavior.¹¹ They do this because according to scans of the midbrain, the person is still 'in love' and waiting for a delayed reward even though they know that the relationship is over.³ This is what the over activation of the orbitofrontal cortex is trying to prevent, but the person is so addicted and distraught that they can override the brain's attempt to block impulses.

This brain activity very well demonstrates a model of a drug addict's brain during the withdrawal phase. Like drug addicts, the same types of stimuli can send a heartbroken person into relapse.¹² Where a drug addict can relapse when exposed to drug related cues such as people they used to get high with or places that they used to use the drug, a person post-heartbreak can have feelings of relapse for their ex when they see places they used to together or mutual friends they used to both see.¹² More obviously, a drug addict can relapse when exposed to the drug itself, just as the heartbroken person will relapse when exposed to their ex-lover.¹³ Therefore, when these people cannot stop ruminating in their relationship it isn't actually their fault; there is a neurological mechanism at work that they can't prevent.

Maybe now you're wondering if love is worth it. Why bother if you form a codependency to the person, and then are left craving a reward that isn't coming when the relationship ends. Or maybe you're thinking back and recognizing these behaviors, either in yourself or a friend or

a family member. You're seeing now the addiction and the withdrawal that is so similar to a recovering or relapsing drug addict. Love is a scary but necessary thing that we will never be able to completely neurologically represent just by displaying some neurotransmitters and brain structures. As studies show, people are overwhelmingly curious about love and how to characterize it, but maybe it just can't be characterized. Love is frightening and elusive and incomprehensible, and no matter how much people know about it they will never know enough.

References

- ¹ Broadfoot, Maria. "High on Fidelity." *American Scientist*. 90.3 (2002): 1. Print.
- ² Diamantaras, Andreas. "Brain Activity in Love." *Charite Neuroscience Newsletter*. 7.2 (2014). 6. Print.
- ³ Laslocky, Meghan. "This is Your Brain on Heartbreak." *Greater Good*. Berkeley.edu. 15 February 2013. Web. 17 October 2015.
- ⁴ Weiss, Robert. "Unmasking the Neurobiology of Love." *HuffPost Science*. Huffington Post. 11 April 2014. Web. 18 October 2015
- ⁵ Gregoire, Carolyn. "4 Things Neuroscience Can Teach Us About Love." *HuffPost Lifestyle*. Huffington Post. 14 February 2014. Web. 05 October 2015.
- ⁶ DiSalvo, David. "What Neuroscience Tells Us About Being in Love." *Psychology Today*. Psychology Today. 12 February 2014. Web. 18 October 2015.
- ⁷ Rudnick, Gary and Wall, Stephen. "The Molecular Mechanism of 'Ecstasy' [3,4-methylenedioxy-methamphetamine (MDMA)]: Serotonin Transporters are Targets for MDMA-induced Serotonin Release." *Proc. Natl. Acad. Sci.* 89 (1992): 1817-1821. Print.
- ⁸ "Drugs and Supplements: Cocaine (Topical Route)" *Mayo Clinic*. Mayo Clinic. 01 October 2015. Web. 19 October 2015.
- ⁹ "The Brain is a Battlefield." *NeuWrite*. NeuWrite. 14 February 2015. Web. 18 October 2015.
- ¹⁰ Johnson, R. "The Biology and Neuroscience of Breaking Up." *Facing the Facts*. Bpfamily. n.d. Web. 17 October 2015.
- ¹¹ Luscombe, Belinda. "The Cruellest Study: Why Breakups Hurt." *Time Magazine*. Time. 09 July 2010. Web. 16 October 2015.
- ¹² Greenberg, Melanie. "The Neuroscience of Relationship Breakups." *Psychology Today*. Psychology Today. 17 April 2011. Web. 18 October 2015.
- ¹³ "An Individual Drug Counseling Approach to Treat Cocaine Addiction." *National Institute on Drug Abuse*. NIDA. n.d. Web. 19 October 2015.
- ¹⁴ Ciliax, Brian. "The Dopamine Transporter: Immunochemical Characterization and Localization in the Brain." *The Journal of Neuroscience*. 15-3 (1995) 1714-1723. Print.
- ¹⁵ Wise, RA and Bozarth, MA. "Brain Substrates for Reinforcement and Drug Self-Administration." *Prog Neuropsychopharmacol*. 5-6 (1981) 467-474. Print.