

Dopamine Activity and its Role In Romantic Love Across Relationship Stages
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ABSTRACT

Background: Romantic love is strongly connected to dopamine, a neurotransmitter that affects motivation and reward. Understanding dopamine's role in love can help explain why love feels exciting as well as why breakups feel excruciatingly painful.

Objective: The goal of this project was to explore how dopamine levels change during romantic love as well as what happens to these dopamine pathways when love fades or ends.

Methods: PubMed was searched with keywords, including dopamine, love, heartbreak, and romance. Studies were included if they focused on dopamine activity in individuals who were in love or going through breakups.

Results: The articles showed that dopamine activity increases during romantic love and decreases when relationships end. These changes help explain mood shifts, cravings, and emotional reactions.

Conclusion: Dopamine plays a major role in how individuals experience love and heartbreak. Learning about these changes helps explain why romantic relationships affect our emotions so significantly.

INTRODUCTION

Many people will have an experience of romantic love at one point or another, and it can be one of the most intense emotions a person will ever feel. Falling in love often brings feelings of happiness, excitement, and a strong emotional attachment towards another person [1]. People may find themselves thinking about their partner constantly, feeling energized just by being around them and looking forward to every interaction [1]. At the same time, when a relationship begins to fall apart or comes to an end, those happy feelings can quickly turn into sadness, heartbreak, and emotional pain that feels impossible to escape [2]. These changes in mood may feel personal, but a great part of what we experience in love strongly relates to what is going on inside the brain.

One of the chemical neurotransmitters involved in romantic love is dopamine. Dopamine is a neurotransmitter that has strong links with pleasure, reward, and motivation, driving behaviors that feel good while encouraging us to repeat those behaviors [3]. In cases where a person falls in love, dopamine inside the brain rises to create feelings of excitement, happiness, and strong emotional attachment [3]. This rise can explain how and why love can be so intense and why people might feel almost addicted to their partner in the early stages of an intense relationship [3].

As relationships grow and change, dopamine activity also evolves [4]. What once was the intense rush of an early love often settles into a calmer, more stable bond of emotions. However, when a relationship ends, dopamine levels can drop significantly, leading to the feeling of emptiness, sadness, and having a lack of energy or motivation [5]. Understanding the stages of dopamine

and how it works helps us realize how powerful love is and how devastating heartbreak is. This article explores how dopamine activity within the brain changes during romantic love and rejection.

METHODS

Peer-reviewed studies were identified using PubMed and Google Scholar. Searches focused on dopamine, romantic attachment, early romantic love, long-term bonding, and breakup-related neural activity. Search terms included “dopamine romantic love,” “VTA activity love,” “romantic rejection fMRI,” “long-term attachment oxytocin,” and “reward system romantic relationships.” . Studies were included if they utilized recognized neuroscientific methods such as fMRI, PET imaging, or resting-state connectivity analysis to measure reward or bonding-related neural activity. Exclusion criteria included studies centered solely on non-romantic social relationships, animal data without human parallels, and behavioral studies lacking biological measurements.

RESULTS

The first paper examined what occurs in the brain during the beginnings of romantic love. The researchers concluded that early love strongly activates dopamine pathways related to reward and motivation [6]. Viewing pictures of one's romantic partner increases activity in areas such as the ventral tegmental area and caudate nucleus, demonstrating how dopamine aids the brain in connecting romantic feelings with reward [6]. These findings indicate that new love is indeed capable of activating the brain's reward system powerfully, similar to other exciting and meaningful experiences [6].

A second, related study elaborated on this theme by demonstrating that dopamine is also linked to cognition and decision-making during early romantic love [7]. The research showed that dopamine activity in the prefrontal cortex increases when people are exposed to romantic images [7]. This indicates that new love does not just alter the way people feel but also how they perceive situations, attach emotional significance, and make decisions [7]. Together, the emotional reward and heightened thinking processes help explain why people in early love often become highly focused on their partner and extremely motivated to maintain the relationship [7].

Instead of focusing on early relationships, a different study targeted long-term romantic love [4]. Unlike the intense dopamine response seen in early love, long-term relationships had more steady and moderate dopamine activation [4]. Even so, married individuals who still reported strong affection for their spouse continued to show activity in dopamine-related areas, including the ventral tegmental area and ventral striatum [4]. This indicates that although the excitement of new love may die down, dopamine continues to play an important function in maintaining long-term emotional bonds by reinforcing positive shared experiences and routines [4].

A fourth study investigated changes within the brain after a romantic breakup [8]. After the dissolution of a relationship, reward system activity was significantly lowered [8]. Individuals experiencing a recent breakup demonstrated diminished connectivity in dopamine-related

regions of the brain, including the caudate nucleus, which reflected the sudden absence of reward signals that were previously associated with one's partner [8].

A final study provided crucial emotional context to these studies by looking at the brain during heartbreak. While reward-related activity decreased, areas involved in craving and emotional pain, including the nucleus accumbens and anterior cingulate cortex, became more active [5]. This closely resembles the brain's response to drug withdrawal, further supporting the idea that romantic love can function in ways similar to an addictive reward process [5]. In general, these studies indicate a clear and relatable pattern: early romantic love is marked by intense dopamine-driven reward; long-term relationships maintain a steadier level of dopamine activity; and break-ups lead to a sharp drop in dopamine-associated reward processing along with increased emotional distress [1-5]. This progression helps explain why falling in love can feel powerful, why long-term love can feel stable rather than overwhelming, and why heartbreak can feel both emotionally and physically painful.

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Study	Aim of Study	Study Participants and Setting	Method	Results
Aron et al. (2005) [6]	Examine neural activity during early romantic love	17 adults currently in intense romantic love	fMRI while viewing beloved vs. neutral person	Strong activation in VTA and caudate, indicating dopamine-rich reward pathway involvement
Takahashi et al. (2015) [7]	Measure dopamine release during romantic-partner viewing	Adult participants in romantic relationships	PET imaging	Increased dopamine release in mPFC and mOFC when viewing partner
Acevedo et al. (2012) [4]	Investigate long-term romantic love	Long-term married adults	fMRI	Persistent activation of VTA and striatum even in long-term relationships
Zheng et al. (2015) [8]	Compare brain activity in in-love, ended-love, and single individuals	Three participant groups	Resting-state fMRI	Ended-love group showed reduced caudate connectivity, suggesting weakened

				dopamine reward signaling
Brown et al. (2010) [5]	Examine brain activity after romantic rejection	Recently rejected adults still feeling strong love	fMRI during viewing of ex-partner	Activation of craving/addiction circuits and distress-related pathways

DISCUSSION

The reviewed studies show that dopamine plays a major role in how people experience romantic love, especially during the early stages when everything feels exciting and intense [6]. When someone sees the person they love, the brain's reward system becomes very active, which explains why people feel happy, energized, and extremely focused on that person [6]. As relationships continue, dopamine works together with bonding chemicals, such as oxytocin, to support long-term trust, comfort, and emotional connection [4]. When a breakup happens or love fades, dopamine activity decreases, and brain areas connected to sadness and craving become more active. This explains why heartbreak feels overwhelming and emotionally painful [5,8]. Since dopamine is involved in reward and motivation, it makes sense that the brain would use the same system during love. The emotions people feel in romantic situations match what dopamine normally does, which is providing excitement, motivation, and strong emotional reactions. A few studies used fMRI scans, which show changes in brain activity but cannot measure specific chemicals directly [6]. Others used PET scans, which can measure dopamine more precisely but requires more invasive procedures [8]. Some studies focused only on people in new relationships, while others included long-term couples or individuals who recently experienced a breakup [6,8]. These differences in tools and participant groups likely affected what each study was able to measure and report.

Limitations

There are limitations in these studies. Many of them rely on brain-scanning machines that show activity but cannot fully measure what someone is feeling. The sample sizes in these studies are often small, and emotional experiences can vary between individuals, so the results may not apply to everyone [4-8].

Future Research

Future studies should observe people over longer periods of time to track dopamine changes from early attraction to long-term bonding and then to breakups. Research should also include more diverse participants to understand how personality, culture, and biology might influence dopamine responses to love [8].

Conclusion

Dopamine is a major part of why romantic love feels powerful, exciting, and sometimes painful. It drives early emotional intensity, supports long-term attachment, and contributes to the distress people feel after breakups [4-8]. Learning about dopamine can help people better understand the emotional highs and lows that come with love and loss, making these experiences easier to recognize and cope with.

REFERENCES

1. Brito, Janet, and Ann Pietrangelo. "12 Things to Know Sex, Emotions, and Intimacy." *Healthline*, 14 June 2019 <https://www.healthline.com/health/healthy-sex/sex-emotions#sex-emotion-and-your-brain>.
2. "Coping with a Breakup: Causes, Feelings, and Moving On | JED." *The Jed Foundation*, <https://jedfoundation.org/resource/the-painful-truth-about-breakups/>.
3. "Fly-Fishing and the Brain - Love and the Brain." *Harvard Medical School*, <https://hms.harvard.edu/news-events/publications-archive/brain/love-brain>. Accessed 8 December 2025.
4. Acevedo BP, Aron A, Fisher HE, Brown LL. Neural correlates of long-term intense romantic love. *Soc Cogn Affect Neurosci*. 2012 Feb;7(2):145-59. doi: 10.1093/scan/nsq092. Epub 2011 Jan 5. PMID: 21208991; PMCID: PMC3277362.
5. Fisher HE, Brown LL, Aron A, Strong G, Mashek D. Reward, addiction, and emotion regulation systems associated with rejection in love. *J Neurophysiol*. 2010 Jul;104(1):51-60. doi: 10.1152/jn.00784.2009. Epub 2010 May 5. PMID: 20445032.
6. Aron A, Fisher H, Mashek DJ, Strong G, Li H, Brown LL. Reward, motivation, and emotion systems associated with early-stage intense romantic love. *J Neurophysiol*. 2005 Jul;94(1):327-37. doi: 10.1152/jn.00838.2004. Epub 2005 May 31. PMID: 15928068.
7. Takahashi K, Mizuno K, Sasaki AT, Wada Y, Tanaka M, Ishii A, Tajima K, Tsuyuguchi N, Watanabe K, Zeki S, Watanabe Y. Imaging the passionate stage of romantic love by dopamine dynamics. *Front Hum Neurosci*. 2015 Apr 9;9:191. doi: 10.3389/fnhum.2015.00191. PMID: 25914637; PMCID: PMC4391262.
8. Song H, Zou Z, Kou J, Liu Y, Yang L, Zilverstand A, d'Oleire Uquillas F, Zhang X. Love-related changes in the brain: a resting-state functional magnetic resonance imaging study. *Front Hum Neurosci*. 2015 Feb 13;9:71. doi: 10.3389/fnhum.2015.00071. PMID: 25762915; PMCID: PMC4327739.