

The Evolution of Love and Long-Term Bonds

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The heart has its reasons,

that reason knows not of

— Blaise Pascal

Humans show incredible diversity in their social systems across cultures and even more variation at the individual level—documenting these differences is enough to keep many relationship scientists busy for their entire careers. In the face of this variation, there are also relationship universals, many of which can be understood as adaptations for solving many of the relationship challenges faced by our intensely social species. In this chapter, we will argue for one such universal: romantic love. We make two central claims. First, following Pillsworth and Haselton (2006), we provide evidence that there has been strong selection for the formation of long-term bonds designed to facilitate biparental care. Second, we argue that the experience of romantic love likely evolved to assist in the formation and maintenance of long term bonds. We review evidence, including the phenomenology, signaling properties, cognitive effects, and physiological underpinnings of love that appear to support the hypothesis that love is a “commitment device.”

The Evolution of Long-Term Bonds

Parental Investment Theory

Any course in evolutionary psychology will begin with grand overarching theories, including Trivers’s theory of parental investment (Trivers, 1972). The theory elegantly predicts that the sex obligated to invest more in offspring, most often the female, will be more selective than men in choosing mates. In turn, the lower-investing

sex, usually male, will vigorously compete with rivals for access to the valuable high-investing sex and will be more open to low-cost mating opportunities than the other sex. When students learn this theory, they often think that it follows that women are “long-term” in their mating orientation and men are not. However, the theory also predicts that members of each sex will invest heavily in offspring if joint parental care increases the chances that offspring will survive to reproductive maturity—and for humans there is much evidence that this was the case over the course of evolutionary history, as well as in the modern world.

The Burden of Raising Human Offspring

Human offspring require huge investments of time and energy. During a woman’s nine-month pregnancy, she needs to increase her caloric intake by eight to ten percent (Dufour & Sauther, 2002). Lactation, which among modern hunter-gatherers lasts for two and a half years or longer (Lancaster, Kaplan, Hill, & Hurtado, 2000), requires an even greater caloric increase of 28% (Dufour & Sauther, 2002). Human offspring, relative to the offspring of other primates, also have an extended juvenile period. Unlike infant chimpanzees who are able from birth to cling to their mothers and are self-sufficient by age five, human children in hunter-gatherer societies do not produce as many calories as they consume until the age of 15 (see Pillsworth & Haselton, 2006 for a review). Since the average interbirth interval is much shorter than 15 years (e.g., Mace, 1999) mothers will often care for multiple dependents at the same time (Pillsworth & Haselton, 2006).

Fathers Benefit from Investing in their Own Offspring

Siblings and parents may assist a woman in caring for her offspring, but it was likely that no other caretaker has as much genetic interest in the offspring as the biological father. Like the mother, a biological father shares 50% of his genes with offspring, whereas grandparents, aunts, and uncles share only 25% or less (Jeon & Buss, 2007). Given the needs of human offspring and the father's genetic interest in offspring, it is likely that ancestral men increased their fitness by investing heavily in their own offspring.

Among modern humans, there is good evidence of fathers' investment. In the Ache, an indigenous hunting population in eastern Paraguay, children whose fathers are present for the first five years of their lives are more than twice as likely to survive than children whose fathers had died and nearly three times as likely to survive than children whose fathers divorced or deserted their mothers (Hurtado & Hill, 1992). In a meta-analysis of the 186 largely preindustrial societies, Marlowe (2000) found evidence of wide variation in fathers' investment, but even at its lowest levels, investment in children was always significantly above zero. Thus, fathers' investment appears to matter, and fathers do invest in children.

Extended Sexual Cohabitation and Pregnancy Risk

Emerging evidence indicates that longer sexual relationships may increase the chances of successful pregnancies. Offspring are only 50% genetically related to their mothers, leading to possible immune system attack of the developing fetus. A hypothesized consequence of this is preeclampsia, a severe form of gestational hypertension that occurs in about ten percent of human pregnancies. The risk of preeclampsia is lower for later pregnancies, and thus was thought by the medical

community to be a “disease of first pregnancies.” Recent studies have shown, however, that the risk level is the same for a woman’s subsequent pregnancy if the pregnancy is with a *new father* (Dekker & Robillard, 2003; Robillard, Dekker, & Hulsey, 1999). Additional evidence shows that for all pregnancies with new fathers, the length of sexual cohabitation predicts preeclampsia risk: it is 40% for conceptions occurring within the first four months of sexual cohabitation and drops to five percent after one year (Robillard et al., 1994). Longer periods of sexual cohabitation are also characterized by higher birth weights (Robillard et al., 1994). The reasons for this pattern are not fully understood, but one possibility is that the mother’s immune system “learns” over time not to reject the genetic material of her partner. In sum, patterns of preeclampsia risk hint at another selection pressure favoring the evolution of long-term bonds.

The Universality of Coupling and Long-Term Bonds

Social scientists often claim that it is difficult to characterize the mating system of humans because the range of mating practices vary widely across cultures, with some permitting polygyny, some polyandry, some monogamy or a combination of these. However, Pillsworth and Haselton (2005, 2006) have argued that coupling—a special partnership between two individuals—may be nearly universal. In most cultures studied, there are social norms governing marriage, marriage vows are typically between two individuals at a time, and marriage involves an implicit or explicit expectation of joint parental care (Brown, 1991; Murdock, 1949, 1967). Polygyny is permitted in 82% of the world’s cultures (Murdock, 1967), but most men in these cultures do not marry multiple wives and instead form socially monogamous unions (Borgerhoff Mulder & Caro, 1983; Kuper, 1982; Murdock, 1949, 1967). Even in polygynous marriages, husbands often feel

particularly bonded to one of their wives and co-wives jealously compete for husbands' affections (Jankowiak & Allen, 1995).

The Commitment Problem

In the previous sections we summarized several lines of work indicating the adaptive advantages of long-term committed romantic bonds: these bonds facilitate biparental care and increase the chances of offspring survival, they may facilitate better pregnancy outcomes, and they are likely to be universal, even when cultures permit other forms of marriage.

Although the advantages of long-term bonds seem clear, long-term mates, like those in most long-term alliances, face a dilemma. Both members of the couple must remain loyal in order for each to gain the long-term fitness advantages of the partnership. At the same time, it is also in each partner's interest to find the best possible partner, and, if a more attractive alternative comes along, to abandon a partner in an established relationship. This conflict of motives produces the *commitment problem* (Frank, 1988, 2001; Hirshleifer, 1987): the benefits of an alliance are gained through mutual commitments, but mutual commitments require the foreclosure of other attractive options.

Commitment to a single individual is complicated by a number of known psychological tendencies. For example, people tend to overvalue immediate benefits relative to long-term gains: benefits to be gained in the future feel subjectively less attractive than those we can obtain right now (Fredrick, Loewenstein, & O'Donoghue, 2003). This explains why diets, health resolutions, savings plans, and other attempted long term commitments often fail. In romantic relationships, the rewards of long-term

bonds become less attractive in the face of the temptation desirable alternative mates. Moreover, over time existing romantic relationships are likely to become less satisfying (Karney & Bradbury, 1995), thus the longer relationships continue the more likely individuals are to seek relationships with attractive alternatives.

How then do romantic partners avoid the temptations of attractive alternatives? One possibility is that there is an experience powerful enough to overcome the temptation to stray from the relationship and that organize behavior in such a way as to solidify and defend commitment to an existing partner. We propose that the experience of love fulfills this function. By this account, love acts as a *commitment device* (e.g., Frank, 1988; Sternberg, 1986) motivating individuals to remain committed to the relationship, signaling this intention between romantic partners, and helping individuals avoid the temptation of attractive alternatives.

Love as a Commitment Device

Frank (1988; 2001) and Hirshliefer (1987) characterized emotions as *commitment devices* that help people to defy immediate, seemingly rational self-interests. People in love often believe, for example, that they have found their one and only soul mate among thousands, millions, even billions of possibilities. The powerful motivation of the experience of love helps them genuinely foreclose other options by acting as an immediate reward or punishment. This facilitates commitment in spite of the fact that many of the benefits of the relationship are unlikely to occur for many years.

Emotions also cause people to behave in highly costly ways. These costly behaviors serve as honest signals of commitment that assure the partner of the individual's intention to commit. Those in love often make extravagant displays of

loyalty, such as sacrificing one's own career, publicly committing to marriage, or even risking one's life (E. N. Aron & Aron, 1997). These signals are hard to fake and therefore believable—only true love would motivate a person to incur those costs. Moreover, feelings of love play a critical role in maintaining social bonds day to day. Across time, love between partners is associated with intimacy, connection, formation of long terms plans, and a desire to be physically close (A. Aron & Aron, 1998; Diamond, 2003; Dion & Dion, 1973; Ellis & Malamuth, 2000; Hatfield & Rapson, 1993; Hendrick & Hendrick, 1992; Sternberg, 1986), and partners who feel more love for each other are more likely to remain together (Sprecher, 1999).

Social-functional accounts of emotion further the claim that love acts as a commitment device (Gonzaga, Keltner, Londahl, & Smith, 2001; Gonzaga, Turner, Keltner, Campos, & Altemus, 2006). The experience of emotion coordinates a number of loosely related psychological, physiological, and behavioral systems to help individuals maintain relationships during ongoing social interactions (Keltner & Haidt, 1999). Emotions, according to this account, help individuals negotiate the moment to moment interactions that lie at the core of social relationships (e.g., resolving conflict, providing social support, etc.).

Romantic love as a human universal

Cross culture evidence supports the hypothesis that love is a universal adaptation that may serve an important relationship function. Jankoviak and Fischer (1998) examined ethnographies from the standard cross-cultural sample of 166 different cultures. In 147 of the 166 ethnographic accounts they found evidence of the existence of

romantic love. In the remaining 19 cultures, there was no evidence presented that romantic love did not exist; rather, the ethnographies merely lacked pertinent data.

In an ambitious doctoral dissertation, Harris (1995) examined ethnographic evidence in 100 cultures representing all general regions of the world, including historical evidence from peoples with disparate literary traditions. She operationalized love using key definitions of romantic love from the relationships literature (e.g., Averill, 1985; Hatfield & Walster, 1978; Lee, 1988; Murstein, 1970; Peele, 1988; Shaver, Hazan, & Bradshaw, 1988; Sternberg, 1986; Tennov, 1999), including requiring features like the “desire for union or merger, both sexual and emotional” and the “exclusivity of the emotion for one particular person.” Based on these theoretically derived criteria, Harris found evidence of love in every culture included in the study. Moreover, in their review of historical evidence, Hatfield & Rapson (this volume) find evidence of romantic love dating to the earliest known writings of the Sumerians. In sum, like socially monogamous unions, the experience of romantic love appears to be universal and stretches back through the known history of humans.

For the remainder of this chapter we turn to the literature that addresses the hypothesis that apparently universal feelings of love act as a commitment device that helps partners to (1) select a mate from a sea of potential alternatives and (2) to maintain long-term bonds. We review evidence on the biological underpinnings of love, the phenomenological signature of love, the behavioral signal of love, and how love addresses one of the most serious threats to a romantic relationship, the temptation of attractive alternatives.

Selecting “The One”

In the search for a mate, individuals face the challenge of choice: given the possibility of indefinite search (Todd & Miller, 1999), what leads people to stop and select “The One” on whom they will focus their efforts to establish a long-term bond? Several lines of evidence indicate that the function of passionate love felt in the early stages of relationships does just this.

The Phenomenology of Passionate Love

The feeling component of emotion plays two important roles. First, it signals important states of affairs to the individual. In turn, the feeling also motivates the appropriate behavior necessary to address the situation (Buck, 1999; Frijda, 1988; Schwarz & Clore, 1996).

Surveys of individuals experiencing love early in relationships point to the powerful motivational qualities of this experience. Tennov (1999) reported on the experience of limerence or the obsessional love that individuals often experience early in relationships. Among the qualities of limerence she found: intrusive thinking about the partner, acute longing for reciprocation, an inability to experience limerence for more than one person at the same time, a fear of rejection by the partner, intensification of the feelings in the face of adversity, and a high intensity of feelings such that other concerns were left behind. Each of these qualities shows how, in the early stages of a relationship, strong feelings of love facilitate a single-minded choice of one partner over others. In addition, this experience makes an individual acutely sensitive to signals from the partner about whether the relationship is likely to succeed.

As relationships start to develop love relates to other experiences that promote relationship growth, including feelings of connectedness and closeness (Sternberg, 1986),

affection (Hatfield, 1988; Hatfield & Rapson, 1993; Hatfield & Walster, 1978), empathy and admiration (Rempel & Burris, 2005), a desire to be near an intimate (A. Aron & Aron, 1991; Hatfield, 1988; Hatfield & Walster, 1978), and positive emotional states that promote approach and intimacy such as desire, sympathy, amusement, and happiness (Gonzaga et al., 2001; Gonzaga et al., 2006).

The Biology of Passionate Love

In a recent study, individuals reporting being passionately in love were induced to feel love for their partner while being scanned in an fMRI machine. The researchers found activation in reward areas of the brain, including the right ventral tegmental area, the right postero-dorsal body, and the medial caudate nucleus (Aron et al., 2005). Using a similar methodology Bartels & Zeki (2000) showed that the experience of passionate love activated areas related to emotions, euphoria, and the experience of having “gut feelings,” the medial insula, anterior cingulate cortex, caudate nucleus, and the putamen. These areas are also activated by psychostimulants, like cocaine.

The experience of love early in relationships may recruit a constellation of neurotransmitters and hormones that lead to obsessive thoughts and behaviors and sensitize the stress response system. One study found that the density of platelet serotonin 5-HT transporters in individuals in the early stages of romantic love was equivalent to that of patients with obsessive compulsive disorder and that both groups were lower than a control group (Marazziti, Akiskal, Rossi, & Cassano, 1999). In another study, participants in the early stages of love had higher levels of cortisol suggesting higher levels of HPA activation or stress response (Marazziti & Canale, 2004). Other researchers have suggested that individuals seek to affiliate in times of stress in an attempt to reduce

the negative effects of the stress response (Taylor, Gonzaga et al., 2005; Taylor, Klein, et al., 2000). Moreover, the reward areas of the brain elicited by love (see above) are all linked to the release of dopamine, suggesting that the experience of love can make interaction with the partner highly pleasurable.

In sum, the phenomenological qualities and biological correlates and love in the early stages of a relationship suggest that love leads to the choice of “The One”, and may motivate actions to initiate and strengthen that relationship. In the next section of the chapter we turn from relationship initiation to relationship maintenance.

Staying Together

The non-verbal display of love

Once a relationship is established, there are new challenges. First, one must assure a partner that one’s feelings are genuine and commitment to the relationship will continue. Second, one must also be sure that the same holds true for one’s partner. A non-verbal signal of love would communicate the internal state of the sender and information about the social environment between partners, evoke similar displays of love, and elicit pro-relationship behavior (Keltner & Kring, 1998).

Is there evidence for a distinct non-verbal display of love? Based on animal, ethological, and laboratory studies (e.g., Eibl-Eibesfeldt, 1974, 1989; Moore, 1985) Gonzaga and his colleagues (2001, 2006) proposed a set of four affiliation cues that were likely behavioral markers of love: head nods, Duchenne smiles¹, positive gesticulation, and leaning toward the partner. In a series of studies on romantic partners they found that

¹ The Duchenne smile recruits both the zygomatic major muscle, which turns the lips upward into a smile and the orbicularis oculi, which creates crow’s feet at the corners of the eyes. These types of smiles are linked to positive emotional states unlike those that do not recruit the orbicularis oculi (Ekman, Davidson, & Friesen, 1990).

these cues reliably signaled the experience of love during positive interpersonal interactions such as the couple discussing their first date. Most importantly, the display of affiliation cues was unrelated to other closely related emotional states such as happiness, desire, and arousal. At least in this context affiliation cues signaled love—and only love—between romantic partners.

Love and Commitment Related Behaviors

Brief social interactions, such as the ones outlined above, often serve as the building blocks for intimate relationships (e.g., Cohan & Bradbury, 1997; Gottman, Coan, Carrere, & Swanson, 1998; Gottman & Levenson, 1986). In this vein some studies have linked the experience of love felt during social interactions with relationship relevant behaviors. Specifically, couples who experienced more love during positive interactions were more likely to solve conflicts in constructive rather than contentious ways, have playful rather than hostile teasing, take each other into account when planning life goals, participate in more activities together, provide better social support, discuss marriage, and most importantly report higher levels of of commitment (Gonzaga et al., 2001; Gonzaga et al., 2006).

Love and the Biology of Commitment

Finally, there is emerging evidence that the experience of love may relate to the biological markers of long term social monogamy. Specifically love may relate to the release of oxytocin, a mammalian hormone, consisting of nine amino acids. It is released both in the Central Nervous System (CNS) and in the blood stream and may promote bonding behavior by reducing anxiety (Carter & Altemus, 1997; Taylor et al., 2000; Uvnas-Moberg, 1998) and/or making social contact and affiliation pleasant (Insel,

Young, & Zuoxin, 1997; Panksepp, 1998). Some claim Oxytocin is one biological substrate of love (Carter, 1998; Insel, 1993).

In one study women who were in romantic relationships had greater increases in oxytocin while recalling a love event than those not in a relationship (Turner et al., 1999). Other studies have shown that oxytocin is released in humans during sexual activity (Carmichael et al., 1987; Murphy, Seckl, Burton, Checkley, & Lightman, 1987) and close body contact (Light, Grewen, & Amico, 2005). Finally, oxytocin reactivity is related to the non-verbal display of love (Gonzaga et al., 2006). Some theorists posit this oxytocin release promotes bonding between individuals who have engaged in sexual activity (Carter, 1998; Hazan & Zeifman, 1999), supporting the notion that pair-bonding supports joint parental care of offspring that result from such unions.

As relationships become established love seems to aid individuals in maintaining the relationship by communicating the intention to commit between partners, organizing and motivating broad classes of behavior that further signal the intention to commit, and possibly eliciting the physiological underpinnings of long term commitment. In the final part of the chapter we turn to one of the primary threats to relationship success, the temptation of attractive alternatives. This challenge presents a profound threat to the relationship and offers a most stringent test of the hypothesis that love acts as a commitment device.

Avoiding Attractive Alternatives

The psychological definition of commitment and the definition used by game theorists like Frank (1988) and Hirshleifer (1987) differ. Psychologists often define commitment as partners' intentions to stay in relationships, pledges of loyalty or

devotion, or feelings of connectedness. For example, Wieselquist and her colleagues defined commitment as "a long-term orientation toward a relationship, including intent to persist and feelings of psychological attachment" (Wieselquist, Rusbult, Foster, & Agnew, 1999; see also Agnew, Arriaga, & Wilson, this volume for another review). Game theoretic commitment, in contrast, is a commitment in which options have been removed; one is forced continue on the path to which he or she has "committed" and cannot retreat across bridges that have been burned. To date, relatively little work has investigated the connection between love and game theoretic commitment—that is, the foreclosure of alternatives.

Alternatives are at the core of commitment problem (Hirshleifer, 1987). To gain the benefits of a long term relationship, individuals in romantic relationships resist the temptation of alternatives that may be more attractive in the moment but endanger the long term prospects of the relationship. How then do individuals resist this temptation?

A number of researchers have addressed this topic and shown that individuals in relationships have psychological mechanisms that reduce the temptation of attractive alternatives. One well studied mechanism is the tendency for individuals in committed relationships to have reduced ratings of the attractiveness of alternative; better known as derogating attractive alternatives. Johnston & Rusbult (1989) showed that individuals who were in committed relationships or manipulated to feel more commitment more likely to derogate alternatives. Simpson, Gangestad, & Lerma (1990) showed that heterosexual individuals in relationships only derogate opposite sex/young alternatives. Moreover, as individuals become more committed they are more likely to derogate highly threatening alternatives (Lydon, Meana, Sepinwell, Richard, & Mayman, 1999; Lydon,

Fitzsimmons, & Naidoo, 2003) and also upwardly bias their opinions of their own partner (Fletcher & Boyes, this volume). In a different line of work Miller (1997) showed that individuals who spend less time attending to photos of attractive alternatives were less likely to break up with their current romantic partner. Attention to alternatives, not surprisingly, is negatively related to satisfaction and commitment to an existing relationship (for a review of this evidence see Miller, 2003; this volume). When individuals are in satisfying romantic relationships they are less likely to notice the existence of attractive alternatives.

While this work has been productive it has not directly tested the effect of love on how individuals process thoughts of attractive alternatives. In a recent study we (Gonzaga et al., 2007) did just this. We showed that when individuals are faced with intrusive thoughts of an attractive alternative they are most likely to suppress the thought of the alternative. While at first this may seem a reasonable course of action, research on thought suppression shows that this strategy is ultimately likely to lead to a rebound of thoughts of the attractive alternative, such that they are more frequent than if one had not suppressed the thought (Wegner, Schneider, Carter, & White, 1987). In a second study, we found that individuals who were induced to feel love for their partner were able to successfully suppress thoughts of attractive alternatives, whereas those who were induced to feel sexual desire for their romantic partner or those in a control condition were not. Thus, the experience of love appears to organize psychological resources to directly counter the threat posed by attractive alternatives.

Across the duration of a relationship love has influence over many of the proximal processes that support finding and keeping a monogamous pair bonding

relationship. As the relationship starts, love provides a powerful motivation to seek and start a relationship with a single individual; it helps you find “The One”. As that relationship develops love organizes disparate systems to meet the challenges, both big and small, that may threaten the long term success of that bond; it helps you keep “The One”.

Conclusion

Voltaire once wrote that “Love is a canvas furnished by Nature and embroidered by imagination”. His quote gives keen insight into human relationships, the evolutionary roots, and day to day manifestations of love. Like Voltaire we have argued that humans have likely evolved to form and maintain socially-monogamous pair bonds to benefit offspring, that relationships have myriad challenges to their long-term success, and that the experience of love helps to address these challenges. Indeed, love appears to organize motives, physiology, cognition and behavior in ways that lead us to select and single-mindedly pursue a partner and then to maintain the bond for several years, decades, or an entire lifetime. Research on love, including that we have reviewed in this chapter, continues to reveal the fundamental importance of love and our closest relationships.

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