

# When Love Dies: Further Elucidating the Existence of a Mate Ejection Module

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As a species, humans are generally serial monogamists; in some cases mating with the same partner for years or even decades. Nonetheless, humans often mate with more than one partner over the life course, meaning that romantic pair bonds often come to an end. Prior research has tentatively suggested that a mental mechanism might exist that facilitates severing the romantic bond between mates. Put differently, because romantic love is a species-typical trait, all members of the human species may come equipped with the mental hardware for both falling in love as well as for ending a relationship. Currently, the evolutionary, cognitive, neurobiological, and genetic underpinnings of human mate ejection have yet to be fully elucidated. We examine each of these factors to illuminate the possible mechanisms that may underpin the human tendency to fall *out* of love.

*Keywords:* mate ejection, evolution, human mating

And I love you dear, but just how long, can I keep singing the same old song?

—Marcus Mumford; “Kansas City”

Well, love was kind for a time; now just aches and it makes me blind

—Mumford and Sons; “Lover’s Eyes”

As numerous scholars have pointed out, romantic love constitutes a human universal (Aron et al., 2005; Buss, 1989, 1994; Fisher, Aron, & Brown, 2006; Fisher et al., 2010) meaning that no society or culture has yet been located where the concept of “love” is vacuous. Indeed, romantic attraction and ultimately long-term pair bonding are a well-entrenched part of human social life (Buss, 1994; Miller, 2000; Ridley, 1993; Wright, 1994). Fisher and her colleagues (Fisher, Aron, & Brown, 2006) contend that the human brain (similar to other mammalian and avian brains) appears to have been specifically shaped by evolution to form deep romantic connections with other humans. As Fisher and colleagues (2006) have also pointed out, Darwin (1871) considered decisions regarding sex and reproduction to be so central to the evolution of life on this planet that he offered an intense treatment of the subject in the *Descent of Man*. In short, the

experience of love and attraction is intricately woven into the social fabric of the human species (Buss, 1994).

If the ultimate goal of an organism—or specifically the genes that manufactured and run that organism (Dawkins, 1976)—is to reproduce, then it stands to reason that something akin to a sex drive (in sexually reproducing organisms) and perhaps romantic attraction should have evolved (Fisher et al., 2010). Generally speaking, however, humans do not mate exclusively with a single partner for their entire lifetime (Buss, 1994; Buss & Duntley, 2011). It is true that modern humans engage in decades long marriages or partnerships, yet roughly half of marriages in the western world will end in divorce (Buss & Duntley, 2011). What is more, high divorce rates and the general tendency to dissolve romantic unions are not a modern or western phenomenon (Borghoff Mulder, 2009; Buss, 1994; Hurtado & Hill, 1992). In his thorough treatment on the topic of human desire, Buss (1994) points out that among the Ache—a foraging population in Paraguay—it is common for most individuals to report more than 11 marriages by the time they reach adulthood. Similar patterns of divorce have been uncovered in populations of hunter-gatherer type societies throughout the world (Marlowe, 2004).

The fact that most human relationships end prompts interesting questions regarding the circumstances, scenarios, and mechanisms by which humans terminate a romantic union (Buss, 1994; Fisher et al., 2010). To be sure, the act of dissolving a romance is often no insignificant event, especially for the individual who is on the receiving end of the rejection (Fisher et al., 2010). Losing a mate represents perhaps one of the most distressing, traumatic and bewildering experiences (outside of the death of a loved one) that an individual can experience (Boelen & Reijntjes, 2009; Fisher et al., 2010). The neurological substrates that underscore the psychological dysphoria associated with rejection are becoming clearer as of late (Fisher et al., 2010). In short, we are beginning to under-

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stand better why rejection by a mate is so painful (Cacioppo, Capitanio, & Cacioppo, 2014). What is less well understood, though, are the mechanisms that prompt one individual to jettison their partner from the relationship in the first place. Equally important and interesting, moreover, once someone has been broken up with what allows him or her to move on? Could there be mental hardware that comes prepackaged in our species that operates as a “mate ejection module,” to utilize the term proposed by Wright (1994; p. 124)?

The idea that a psychological mechanism might exist for relationship ending is not a truly novel suggestion conceived of herein (see Buss, 1994; Rasmussen, 1981; Wright, 1994). As Buss (1994, p. 171) has noted, “Ancestral conditions that favored the dissolution of a mateship constituted a recurrent adaptive problem over human evolutionary history and thus imposed selection pressures for the evolution of strategic solutions.” Put differently, the capability of emancipating themselves from certain relationships could have conferred a fitness benefit for ancestral humans (Buss, 1994). What has yet to be coherently articulated, however, concerns what exactly might constitute the human mate ejection module. Is the capability of ending relationships an evolutionary adaptation in our species that was favored by natural selection, is it a by-product of some other adaptation, or does it exist because of random genetic noise (Buss et al., 1998; Tooby & Cosmides, 1990, 1992)? What are the neurobiological underpinnings of mate ejection (i.e., what in the brain makes it possible to move on from a mate)? Furthermore, how might researchers quantitatively assess a mate ejection module using, for example, a survey research instrument? In addressing these topics there will certainly be complexities that must be dealt with (e.g., polygamy and polygyny) along the way. However, the topic of mate ejection seems to be one worth delving in to more deeply.

The current review is intended to explore the existence of mate ejection by drawing on multiple lines of research from a variety of disciplines. We ultimately suggest four possibilities concerning mate ejection in humans: (a) something akin to a “mate ejection module” exists in humans and represents a culturally invariant trait; (b) men and women will differ regarding when, and under what circumstances, they will use their mate ejection devices (sexual dimorphism); (c) mate ejection should exist in two inter-related forms—primary and secondary; and (d) whereas all humans will possess a mate ejection capacity, there will be between individual variation in the ability and tendency to eject mates. Like most human traits (Turkheimer, 2000), genes will account for a moderate portion of the variance in mate ejection (which is to say that mate ejection is heritable), with the rest owing to unique environmental influences. In addition to these four propositions, there are three corollaries regarding mate ejection that require further explanation.

First, Fisher, Aron, and Brown (2006) have distinguished three broad and interwoven aspects of human mating which include the sex drive, romantic attraction, and attachment. It would make evolutionary sense that these three facets of mating would be closely connected to each other. To some degree, we are concerned with what happens once the point of romantic attraction and attachment has taken place yet one mate loses interest in their partner. Additionally, we are also concerned with the individual who is ejected and how they progress forward in the wake of being left by their spouse. That said, purely sexual encounters (prompted by the sex drive and that may

or may not lead to a partnership) are also of interest and relevance. “Moving on” from an otherwise short-term liaison might have had its benefits in our ancestry. It could be perfectly logical from the perspective of the gene to avoid attachment to each and every sexual partner (Confer, Perilloux, & Buss, 2010). Mate ejection would almost certainly be important for these scenarios as well. As a result, we view mate ejection as having relevance across all stages of the human mating process (sex drive, romantic attraction, and attachment). We see no immediate need to make hard distinctions between them, although future iterations of our theory might wish to do so.

Second, at various instances in human history a considerable number of cultures (most of them, in fact) have permitted the romantic involvement of multiple females with single males (polygyny and polygamy; Buss, 1994; Daly & Wilson, 1983, 1988; Murdock, 1967). At first blush, this seems antagonistic to the existence of mate ejection given that in instances of polygyny such a device should not be needed. However, serial monogamy could simply represent a special case of polygyny in that certain males (via a string of divorce and marriage) monopolize (in effect) the fittest females in the population for their own reproductive ends (other researchers have suggested this, see for instance Borgerhoff Mulder, 2009). In cases where a male monopolizes multiple wives, one wife may naturally absorb more resources than other wives; moreover, considerations must also be undertaken on the part of females (or their families, perhaps) concerning whether a male has enough resources to spread between the additional wives of a potential husband (Borgerhoff Mulder & Schacht, 2012; Borgerhoff Mulder, 1990; Buss, 1994). In hypothetical situations of this nature, mate ejection could facilitate a redirection of resources to other—more reproductively fit—mates (Borgerhoff Mulder & Schacht, 2012).<sup>1</sup> If these points are to be believed, then a mate ejection device would maintain value in polygynous cultures without any appreciable barriers to its existence (we develop this line of thinking in more detail below).

The third corollary concerns additional detail related to primary versus secondary mate ejection (which to the best of our knowledge, represents the first proposal of such terminology). Primary mate ejection occurs when one partner makes an active decision to jettison their mate. Conveniently for our purposes, other evolutionary psychologists have already illuminated many of the triggers that likely initiate primary mate ejection in males as well as females (these are discussed in some detail in the section that follows). Secondary mate ejection, on the other hand, is a cognitively based experience in which the individual who has been jettisoned reaches a point when attraction or devotion to a *new mate* becomes possible. As a thought experiment, imagine that an individual has undergone a separation. Regardless of the reason for the separation, regardless of whether the split was amicable and regardless of whether one spouse might still have lingering emotional attachment, secondary mate ejection allows the individual to develop new attachments to other mates.

Primary and secondary mate ejections are conceived of here as mechanisms that operate separately and (in some cases) independently of one another. It would be possible, though, to experience secondary mate ejection in the absence of primary mate ejection;

<sup>1</sup> We thank an anonymous reviewer for bringing this to our attention.

such that one person is unwittingly broken up with and through the process of secondary ejection moves on to a new relationship. Additionally, secondary mate ejection could occur in the wake of primary mate ejection (i.e., in the same individual). With these thoughts in mind, the review will proceed as follows. We begin first by reviewing the literature surrounding the possible evolution of a mate ejection device. In this portion of the article it is necessary to be broad in our discussion of mate ejection, so at times we will not distinguish between primary and secondary mate ejection. Once we have made a case for the existence of mate ejection in general (and the triggers that predict it), we then offer a more fine-tuned examination of the phenomena via a discussion of the possible neurobiological substrates of mate ejection.

### The Evolution of Mate Ejection

In the wake of Darwin's (1859, 1871) writings on evolution and natural selection, eminent biologists have worked to clarify the process by which complex functional adaptations emerge under the oversight of natural selection (see, e.g., Dawkins, 1976; Williams, 1966). Given the narrow spectrum within which adaptations must be defined (see Buss et al., 1998; Tooby & Cosmides, 1990, 1992), the search for adaptations (psychological or otherwise) requires careful consideration on the part of the theorist. Should the trait in question fail to meet the standards proposed for adaptation, the conclusion must be that the outcome in question is either the by-product of some other adaptation, or it is the results of random genetic noise (Tooby & Cosmides, 1990). Using the phenotype of rape as an example, Palmer (1991, p. 368) illustrates the definitional narrowness that adaptationists work within: "The question of adaptation versus by-product now becomes whether the mechanisms involved in rape have been selected for rape itself, or for a variety of other types of behaviors." The exact same type of scrutiny must be applied to mate ejection. The deeper question involves whether the "mechanisms" involved in mate ejection are in place "solely" or at least generally to eject mates for the purpose of solving a recurrent ancestral problem (Buss, 2004; Palmer, 1991; Pinker, 1997). Along these lines, the primary consideration would seem to be whether relationship ending has anything to do with the ultimate recurrent evolutionary problem: reproduction.

### The Evolution of Mate Ejection: Why Men and Women Leave

All members of a species—male and female (in sexually reproducing organisms)—struggle, compete, and strive (unconsciously and consciously) to propagate their genes (Buss, 2004; Dawkins, 1976; Ridley, 1993). Within the confines of reproductive strategies, there is a rich literature pertaining to the sexual dimorphism that exists between men and women in terms of the evolved tendencies surrounding sex (Aitken et al., 2013; Bereczkei et al., 1997; Cashdan, 1996; Ridley, 1993). There are other systematically executed reviews that are widely known on the subject so we offer only a cursory overview here (Ridley, 1993; Symons, 1979). Essentially, the goal is the same between men and women: produce offspring. However, given the differences that exist in terms of parental investment, the approaches are necessarily divergent (Buss, 1995; Mealey, 2000; Ridley, 1993). As we mentioned earlier, it is reasonable to suspect that mate ejection should be a

component of both male and female psychology yet it should display some degree of differentiation across males and females. Therefore, a heuristic device in this case would center on the instances and occurrences that prompt men and women to perpetrate primary mate ejection.

One obvious place to begin seems to be the experience of and the reaction to infidelity (Betzig, 1989; Buss, 1994; Buss & Shackelford, 1997a). To no great surprise, both sexes react negatively to infidelity on the part of their spouse (Treas & Giesen, 2000), yet there appear to be gender differences regarding the nature of the jealousy experienced and the course of action chosen by the individual who was cheated on (Sagarin et al., 2003; Shackelford et al., 2002). The differences in the action ultimately chosen by men versus women are often shaped by the nature of the infidelity (Shackelford et al., 2002; Symons, 1979). Was the other partner sexually unfaithful, or did their infidelity take the shape of an emotional attachment to another person? The distinction is important. Because men must guard against the constant threat of cuckoldry, or unknowingly raising an offspring that is not biologically their own (Buss & Duntley, 2011; Buss & Schmitt, 1993), infidelity of a sexual nature poses a fitness risk. Females—always certain of maternity—face threats regarding the loss of important resources if a mate were to leave (Shackelford et al., 2002). For these reasons, males are expected to initiate mate ejection (both primary and secondary) in response to their partner's *sexual* infidelity. Women are expected to initiate mate ejection in response to *emotional* infidelity.

Shackelford and his colleagues (2002) examined male and female decisions to either reconcile or break-up depending on the nature of the infidelity of the partner. Over 250 participants were presented with a variety of scenarios in which they were asked to consider which out of a series of events would disturb them more. Would it be more hurtful, for example, to imagine a romantic partner enjoying sex with another person or would it be more painful to imagine that person forming a lasting emotional bond with someone else. The respondents were also asked to gauge which type of scenario would be most difficult to forgive. Perhaps not surprisingly, men were much more disturbed by, and less likely to forgive, situations where their partner was sexually unfaithful.

Males, who face the threat of cuckoldry, concern themselves more with sexual infidelity in the study mentioned above. For females—who never risk being cuckolded—resources contributed on the part of the male toward the female and the offspring are of paramount importance (Buss & Schmitt, 1993; Ellis, 1995; Klinkova et al., 2005; Platek & Shackelford, 2006). Traits such as status, social rank, and resource access signal to females that a particular male is fit in a variety of ways, not the least of which concerns their capacity to take care of a family (Buss, 1994). In the study conducted by Shackelford and his colleagues (2002), females were less likely to seek reconciliation when the imagined transgression was emotional infidelity (a scenario in which a male might begin diverting resources to a sexual liaison that has morphed into an emotional attachment).

Ultimately, female mate ejection devices should be especially primed when males cease to represent "safe bets" in terms of resources (Buss, 1994; Pawłowski & Dunbar, 1999). At least one litmus test for this assumption might be to consider whether mate ejection is likely when modern females are in a position to "fend for themselves" in relationships that have taken a downward turn.



At least some evidence suggests that female employment—which permits a degree of self-provisioning—can act as a mechanism allowing females to jettison a mate from an otherwise unhappy relationship (Schoen et al., 2002).

### Adaptation Versus By-Product

To this point, we have attempted to argue that mate ejection exists as a component of the evolved psychological repertoire of all humans and that both males and females will jettison mates under certain (sexually dimorphic) scenarios. There are additional—indeed very important—considerations that we have yet to sort out, however. Primary among these is the issue of whether mate ejection exists because it was directly favored by natural selection, which would be to say that it is an adaptation (Palmer, 1991; Pinker, 1997; Tooby & Cosmides, 1990; Williams, 1966), or whether mate ejection exists as the by-product of some other mental adaptation (Tooby & Cosmides, 1990). Finally, we should consider whether mate ejection could owe its existence to random genetic noise in the evolution of our species (Tooby & Cosmides, 1990).

Earlier we reviewed a portion of the evidence surrounding when men and women should be at a higher likelihood of ejecting mates. The common theme in each case surrounded the issue of fitness. Men (on average) appear to eject women in instances when paternity seems uncertain (Buss, 2004). Female mate ejection decisions (on average) revolve around the threat that resources are being diverted; again, an outcome that could imperil fitness (Buss, 1994, 1995). This is a simplification of the literature, but it captures the primary point. Mate ejection, in this case primary ejection, solved a very specific recurrent problem: how to get rid of a mate who might otherwise compromise fitness (see also Buss & Duntley, 2011; Rasmussen, 1981). Additionally, failure to move on from a breakup could also represent no less of a fitness barrier in the sense that unrequited pursuit is perhaps unlikely to lead to reproduction (although see Thornhill & Palmer, 2001 for a related conversation).<sup>2</sup>

Within the framework of adaptation versus by-product, there is an additional possibility worth considering that could map with the existence of mate ejection and that involves the issue of resource allocation among mates. In the course of traversing time, our species has engaged in practices of polygamy and polygyny as well as something resembling serial monogamy, yet at least one problem has remained fixed across the deep time of evolution. When multiple mating opportunities are permitted culturally (or they are engaged in surreptitiously) this manifests the possibility of multiple offspring with multiple wives. As described earlier, such a scenario immediately injects conflicting and countervailing problems for both males and females (Borgerhoff Mulder & Schacht, 2012; Borgerhoff Mulder, 1990; Buss, 1994). For females, concerns revolve heavily around extracting resources and attention from their mates. For males, there are decisions that must be made regarding resource allocation (see Buss, 1994 for a more thorough treatment surrounding the ancestral problem of polygyny than what we can offer herein).

Indeed, this represents the “environment of evolutionary adaptiveness” (EEA) in which mate ejection would have potentially arisen (Buss et al., 1998). As Buss and colleagues (1998; see also Tooby & Cosmides, 1992) note, the EEA encompasses not a

specific time and place but rather the selective pressures and the overall evolutionary process that engrained a particular trait (mate ejection) into our genetic makeup. As a result, the trait develops with fidelity in every generation of offspring. For mate ejection, the EEA refers to the process by which competition over mates (including in both polygynous and serially monogamous circumstances) gave rise to the need to consider tradeoffs between one mate versus another (Buss, 1994).

Certainly, there are multiple factors that might inform these decisions, some of which are tied directly to paternity such as whether the child resembles the father (Alvergne, Faurie, & Raymond, 2009). As a thought experiment, consider that a father begins to question that a child is in fact his. In this case of suspected cuckoldry, the male has only a limited number of options: (a) continue expending resources on the mate and child, (b) given the risk associated with the first option, a second option involves slowly siphoning off resources from one mate and directing them toward another, (c) abandon the mother and offspring entirely (see also Buss, 1994). The complexity with which all this might happen, and the counteradaptations that would have evolved on both sides to limit either the odds of cuckoldry, abandonment, and so forth, are interesting in their own right (see Buss, 1995; as well as Buss & Duntley, 2011 for a discussion on a number of these issues). At issue in the current review, though, concerns what might permit these mental calculations concerning resource allocation to be acted upon.

Primary mate ejection could exist as a functional device designed to transfer and focus resources from one mate to another. For males in need of making adjustments regarding where their resources are flowing, primary mate ejection could have evolved as an unconscious retraction of the affection felt between partners allowing for a redistribution of resources. With time, and the continued evolution of attraction and love in our species, the purpose of mate ejection could have shifted, although perhaps not too drastically. In modern society, when questions of resource allocation are mandated by the state in the form of child support, it still would not obviate the need for mate ejection. Primary mate ejection, along with the emotional uncoupling which results from secondary mate ejection, would still exist in times when males are deciding where to allocate resources and females are directing (or redirecting) their affections toward someone capable of providing investment in their offspring.

As of right now, though, it is most decidedly too early to reach a clear conclusion regarding the adaptation versus by-product argument. However, it seems reasonable to say—at the very least—that ejecting a mate might be of paramount importance in the case of males unsure of their paternity. The risk of allocating finite resources to children who are not your own is evolutionarily untenable for males (Buss, 1994). To the extent that certain an-

<sup>2</sup> To be sure, there are other mechanisms that evolved to deal with compromised fitness because of a mate—jealously, for instance (Buss, 2000). However, jealousy might be better conceived of as a radar-like device that helps detect compromised fitness. Something else might also need deployment to act on the intelligence provided via jealousy. We submit that mate ejection might serve that purpose. It is also reasonable to point out that other factors influencing mate selection—assortative mating in particular—may act as a countervailing mechanism in place to prevent mate ejection before it becomes necessary (see Buss, 2000 for more detail in this regard).

central males successfully ejected unfaithful mates, better allocated their resources among retained mates, and fathered more children, then the genes for mate ejection would have proliferated. These possibilities point—tentatively—toward mate ejection being an adaptation.<sup>3</sup> What might be argued with a bit more assertiveness, though, is that random genetic noise seems an unlikely explanation for mate ejection. Given the consistency with which relationship ending exits in the human species cross culturally (and intergenerationally in the same cultures), the odds that it emerged because of genetic noise seem low (see [Tooby & Cosmides, 1990](#) for more detailed discussions surrounding adaptation, by-product, and genetic noise).

### The Neurobiology of Mate Ejection

So far, our discussion has centered on broad conceptions regarding how, and under what circumstances, a mate ejection device could have evolved in our lineage. At this point, it is necessary to dive further into the exact neurological hardware that may underpin what happens when humans decide to leave their mating partners. An important point to keep in mind is that the above sections—rooted in evolutionary psychology—refer to the existence of a single module that constitutes the mate ejection device. What should not be misunderstood, however, is that multiple neurological systems will likely be accessed during mate ejection, but this does not run counter to the notion of a single mental module. Nor does the discussion of adaptation versus by-product diminish the need to understand what happens in the brain during mate ejection. Regardless of whether mate ejection evolved as an adaptation or a by-product (or even if it is genetic noise), the cognitive experiences are real, they take place in the brain, and they are worth understanding in their own right.

### The Brain in Love

The increasing incorporation of neuroimaging techniques when investigating psychological phenomena is pushing the study of the human mind forward. In the case of romantic love, neuroimaging analysis of subjects who report currently being in love, as well as those who report enduring the end of a relationship, are helping to provide insight into the origins of attraction and romance in humans ([Aron et al., 2005](#); [Fisher et al., 2006](#); [Najib et al., 2004](#)). More important, for the current purposes, these studies are revealing what might be happening in the brains of individuals as they contemplate, and then act on, a desire to break up with their current mate.

In a study using functional MRI (fMRI), [Aron et al. \(2005\)](#) examined the neural underpinnings of romantic love in a sample of 17 men and women who reported being “intensely in love.” For the subjects who reported being in love, fMRI analysis revealed a detectable increase in neuronal activity in the right ventral tegmental area (VTA) along with other brain regions ([Aron et al., 2005](#); [Fisher et al., 2006](#); [Najib et al., 2004](#)). Given the particular neural pathways that have been associated with the experience of romantic attraction and love, it is not surprising that researchers have equated the feelings associated with love as being analogous to an addiction ([Fisher et al., 2010](#)).

The neural substrates correlated with cocaine use, as well as dopaminergic rich reward pathways, are implicated in the feelings

associated with romantic attraction and may also help explain the attachment that often follows the initial feelings of physical infatuation with a potential mate ([Aron et al., 2005](#); [Fisher et al., 2002](#); [Fisher et al., 2010](#); [Griffin-Shelley, 1991](#)). Given the close association of love with addiction, moreover, the severe mental distress associated with the experience of rejection by one partner should become less surprising ([Fisher et al., 2010](#)). Some have also suggested that behaviors analogous to stalking may arise as an attempt to retain a mate when the addiction circuits of the brain become active ([Meloy & Fisher, 2005](#)). This would not be entirely anathema to an addict seeking out another dose of their favored substance.

In a recent study of 10 females and 5 males, all of whom had been recently rejected by a mate, fMRI results revealed activation across a variety of regions including the orbitofrontal and prefrontal cortex (as well as others such as the VTA and the ventral striatum; [Fisher et al., 2010](#)). These results inform the current discussion in two ways. First, they suggest that similar regions of the brain (the VTA specifically) are implicated in romantic attraction, regardless of whether the attraction is ongoing or whether it is occurring while the individual is being rejected ([Fisher et al., 2010](#)). Second, many of the neural systems overlap with reward or pleasure and addiction systems in the brain, which suggests a mechanism for persistent mate retention activity (i.e., stalking; [Meloy & Fisher, 2005](#)). Ultimately, trying to move on from a former mate (secondary ejection) may be similar in some ways to an attempt at breaking a drug habit ([Fisher et al., 2010](#)).

With this in mind, it might be helpful then to examine what exactly happens in the brain of an actual addict (in this case, one addicted to cocaine) once use has been terminated ([Connolly et al., 2013](#)). At least some evidence exists suggesting that persistent cocaine abuse is linked to diminished gray matter volume in the frontal regions of the brain (as well as across other neural regions; [Connolly et al., 2013](#); [MacKey & Paulus, 2013](#)). Abstinence from cocaine use, however, is associated with greater gray matter volume across various brain regions ([Connolly et al., 2013](#)). The results produced by [Connolly and colleagues \(2013\)](#) are to some degree expected if improved functioning in various cortical (and subcortical) structures of the brain is necessary for avoiding future drug use. Juxtapose these results with those from [Fisher and her colleagues \(2010\)](#) who also examined a variety of neural structures implicated in addictive-type behaviors. [Fisher et al. \(2010, p. 56\)](#) begin to touch on important issues potentially related to mate ejection by stating: “Because this extended system was activated when our subjects viewed their rejecter, we speculate that these romantically rejected men and women were engaging reward eval-

<sup>3</sup> It is also worth considering the possibility that mate ejection exists as a by-product of the mental mechanisms designed to accomplish goals like avoiding cuckoldry, retaining a mate, etc. However, this seems less likely as mate ejection is something that either occurs or does not occur outside of these mental processes (although, it would most assuredly be related to them).

uation systems to assess their situation and adjust their behavior accordingly, an adaptive response.”<sup>4</sup>

What this potentially means is that mate ejection (most likely secondary ejection) represents a process in which individuals engage in a calculation—to some degree—concerning whether or not to pursue their previous mates further, or whether further pursuit might represent a fruitless enterprise (Fisher et al., 2010). If pursuit is indeed fruitless, then the brains of individuals may act in such a way as to correct certain emotions and behaviors, paving the way for targeting other mates for attraction and pursuit (i.e., why pursue someone who has completely lost interest?). A key question in all of this, though, is does the brain show any evidence of being capable of correcting “disadvantageous” behavior in humans (outside of conscious deliberation).

Utilizing a game-based approach, evidence has emerged concerning the brain’s ability to bias choices away from disadvantageous strategies and toward better strategies that produce more positive outcomes over time (Bechara et al., 1997). In a game known as the Iowa Gamblers Task, subjects are asked to draw cards from four different decks; two decks result in diminished payouts in the short term but larger long-term gains (i.e., the better strategy). Two decks produce more in the short term but become costlier as the number of draws increases over time. More important, before subjects gaining conscious knowledge regarding which deck is better in the long run, the brain seems to *unconsciously* push respondents toward decks that produce the larger long-term benefits (Bechara et al., 1997). Impairment in certain regions of the prefrontal cortex, moreover, prevents the redirection of strategies (Bechara, Damasio, & Damasio, 2000).

Taken on the whole, the research above paints a theoretical—albeit speculative—picture of what might be happening during secondary (and perhaps even primary) mate ejection. Once an individual has been ejected, regions of the prefrontal cortex (as well as other areas) begin the process of “learning” to move past their previous mate. Pursuing a mate who has lost interest may be analogous to drawing cards consistently from the wrong deck: a strategy that is costly in the long run (aside from the fact that it will reach a point where it becomes illegal; Meloy & Fisher, 2005). If the rest of the life course were occupied with attempting to retain the affections of someone who wants nothing to do with you—as opposed to pursuing someone who might—then the odds of genetic death (e.g., lack of offspring) could go up. Moreover, remaining with the wrong mate (i.e., one who is unfaithful or who lacks resources) could equally represent playing a card from the wrong deck and primary mate ejection could act to correct this in the long run (using similar brain systems).

### A Brief Aside on the Neurochemical Underpinnings of Mate Ejection

Fisher and Thomson (2007) presented an interesting thesis regarding the effect that a particular family of antidepressant medications—selective serotonin reuptake inhibitors (SSRIs)—might have on feelings of romantic love and attachment. In particular, Fisher and Thomson (2007) argued that by artificially increasing levels of serotonin (the target effect of SSRIs), one may effectively ward off certain pathologies (i.e., depression, anxiety, etc.), yet a less anticipated consequence could also involve an emotional apathy toward ones’ partner. For example, consider the findings

linking dopamine and norepinephrine levels to feelings of romantic attraction (Fisher et al., 2002). In part, these particular chemicals likely underpin the “addictive” and “obsessive” aspects regarding the behavior of one mate toward another in a romantic relationship (Fisher & Thomson, 2007).

More important, increased levels of serotonin can suppress both dopamine and norepinephrine levels (Fisher & Thomson, 2007) and, as a result, may stifle romantic feelings. What is more, increased serotonin can erode testosterone levels—a correlate of sexual interest and arousal (in both men and women; Fisher & Thomson, 2007). This can become quite important if the result is that a female (or a male) begins to withhold sex from their partner. For men, this might trigger a preference for sexual variety (Buss, 1994), thus increasing the likelihood of infidelity. Should that infidelity grow to the point where it involves siphoning off resources from their spouse, then it could ultimately trigger the females mate ejection module. Clearly, SSRIs are a novel invention and did not exist in the environment of our ancestors as a trigger of mate ejection. Even so, this does not negate the potential importance of serotonin as one potential pathway for mate ejection. If one is searching for a neurochemical mechanism for mate ejection then, it is perhaps logical to start with serotonin.<sup>5</sup> At this point, though, these suggestions are merely speculative.

### The Sources of Variation for Mate Ejection

Given the possibility that a mate ejection device in humans was shaped either directly or indirectly by natural selection, it stands to reason that at least some of the variation—perhaps a good portion—will be accounted for by the environment (Buss, 1995, 2004; Penke, Denissen, & Miller, 2007; Tooby & Cosmides, 1990). As mentioned above, the environmental trigger of spousal infidelity could prompt both men and women to dissolve a romantic union (although perhaps for different reasons). Even so, not all individuals who have reason to do so will ultimately break off the relationship. Indeed, some individuals persist in the union, even in the face of more severe environmental insults such as physical abuse (Buss & Duntley, 2011; Dugan, Nagin, & Rosenfeld, 1999).

Given the heterogeneity that exists for ending relationships, it is likely that mate ejection tendencies lie along a continuum. At opposite tales of the distribution, individuals are either very likely, or very unlikely to end a relationship. This is not to say that individuals falling in one tail of the distribution would be incapable of ending a relationship. Rather, that they would be expected to feel either exceedingly conflicted (or exceedingly self-assured, depending on their location along the curve) regarding a decision to break up with their partner. Should such a continuum exist, it might offer some insight into why some victims of domestic violence are less likely to distance themselves from their abuser than others (Dugan et al., 1999). The environment, however,

<sup>4</sup> Certainly, it could be as Fisher and colleagues (2010) suggest in that activations of this nature in the brain have more to do with reacquisition of mate, as opposed to ejection of that mate.

<sup>5</sup> One might argue that males have no need for a “trigger” when it comes to seeking sexual variety. Indeed, it is completely logical to suggest that the nature of male sexuality is such that multiple sexual encounters could be beneficial (resulting in multiple conceptions) (Buss, 1989). At some point, a male will likely form an attachment with a female, which by extension might call for mate ejection under certain circumstances.



should only account for a portion of the variation in mate ejection. Genetic factors should also play an important part.

Initial evidence for genetic involvement in mate ejection can be gleaned from behavior genetic studies on divorce in families. Prior heritability estimates, for instance, suggest that the occurrence of divorce is between 30% and 40% heritable (Jocklin, McGue, & Lykken, 1996). This is not to say that divorce is inherited 30% or 40% of the time, but rather that between 30% and 40% of the variance in the threshold position for divorce is accounted for by variation at the genetic level (Turkheimer, 2000). More accurately, what it means is that individual differences in the personality traits underlying the experience of divorce are influenced by genes (see Eysenck, 1980 as well as Buss & Shackelford, 1997b for insight regarding the personality correlates of relationship ending). Other studies conducted in the intervening years have also offered reason to think that family structures (i.e., single parent homes) are not randomly distributed in the population and that genes play an important role in the selection process (Cleveland et al., 2000).

There is one minor point worth mentioning regarding research on the heritability of divorce. Although informative, these studies necessarily restrict the discussion of mate ejection to situations in which individuals are married. This is interesting, yet mate ejection devices should be expected to operate in conditions other than marriage and would be pertinent to understanding why longstanding romantic partnerships in general are dissolved. Viewed in this light, a mate ejection device would likely be underpinned by various temperamental and personality traits which in and of themselves act to increase the likelihood of leaving a mate.

### A Brief Note on Measurement

There are at least two possibilities concerning the measurement of mate ejection as we conceive of it. First, it should constitute a constellation of feelings, or even a general cognitive state, regarding the feelings of one mate toward their partner. For instance, in case studies examined by Fisher and Thomson (2007) patients taking SSRIs reported feeling something akin to apathy toward their loved one. One patient, for example (cited from Fisher & Thomson, 2007, p. 257) stated that she had “. . . not been as much in love” with her boyfriend and that she was “. . . not as interested in intimate time with him.” As Fisher and Thomson (2007) point out, the participant had recently undergone an increase in the levels of SSRI that she was taking, which could have preempted her feelings. Even so, similar questions could be included in survey instruments aimed at assessing one’s tendency to jettison mates. Survey instruments could be designed to assess the respondent’s history of quickly losing interest in a partner, their tendency to quickly and frequently desire space from their partner, and the tendency to reminisce about the past pleasure of being single and unattached. Boelen and Reijntjes (2009) analysis using the Grief Cognitions Questionnaire might also be instructive when trying to assess the experience of secondary mate ejection. These scholars found evidence that certain negatively charged cognitive states were tied to the upset surrounding mate ejection (Boelen & Reijntjes, 2009). Additional research in this area will no doubt be fruitful.

The second possibility involves direct measurement of physical structures in the brain. Given the near exponential growth in the use of neural imaging techniques, an ideal approach would be to

examine all the structures mentioned above in individuals who were considering whether to jettison a mate (or who had already done so). Understanding the actual structures in the brain that become active when either primary or secondary mate ejection is underway will provide the physical links in the causal chain leading from calculations about mate ejection (i.e., resource or infidelity considerations) that might ultimately prompt jettisoning a romantic partner.

Researchers should also consider examining overt measures of mate ejection (i.e., divorce, separation, break-up, etc.). There is a caution worth mentioning, though. Although these types of items make for interesting and informative analysis, it would be (perhaps) disadvantageous to use behavioral indicators as the *sole* measure of mate ejection. The primary reason for this is that such items offer relatively little insight into the cognitive processes that underpin the act of falling out of love. Events such as a break up might be viewed as indicators of a mate ejection system but perhaps not the system itself. Rather, these events are the *outcomes* of the mate ejection system. This is not to say that behavioral indicators are of no use, only that when possible reliance on attitudinal and emotional measures would be preferred for assessing mate ejection and its cognitive/personality structure. Ideally, the implementation of multiple measurement strategies—including neurological imaging to continue pinpointing the precise regions involved in decisions to breakup—would make the longest strides in unpacking the process of mate ejection.

### Limitations

The current manuscript is not without limitation and these weaknesses should be given their due consideration. First, our conceptualization and operationalization of mate ejection can and should be extended in future research on the topic. There could be alternative ways in which to conceive of and measure mate ejection and future research will help elucidate what is most appropriate. Second, we have provided little in the way of discussion concerning the nature of mate ejection in homosexual relationships. This was intentional, however, considering that we see no reason why mate ejection should work differently in homosexual versus heterosexual relationships. Indeed, differences that appear to exist in terms of the sexuality of homosexual males and females (Bailey, Gaulin, Agyei, & Gladue, 1994; Buss, 1991, 1995; Symons, 1979) may provide support for our argument in relevant ways. Homosexual males, for instance, exhibit (on average) many of the same heterosexual male proclivities for increased sexual variety as opposed to homosexual females who place increased emphasis on monogamy (Symons, 1979). More important, there is at least some reason to think that homosexual males report greater distress when asked to consider infidelity on the part of their partner that involved sex (as opposed to emotional infidelity; Bailey et al., 1994). Homosexual females report the opposite (i.e., appear similar to heterosexual females; Bailey et al., 1994). If these findings are to be believed, it lends credence for our position that mate ejection is a species typical trait with clear sexual dimorphism even in homosexual populations. It should be noted, though, that the findings regarding sexual orientation are preliminary—and have been challenged—thus more research is needed (DeSteno, Bartlett, Braverman, & Salovey, 2002; Harris, 2002, 2003).

Broadly speaking, mate ejection exists—in some ways—as a rather banal aspect of the human condition. Humans pursue and choose mates, they involve themselves romantically for a period of time (perhaps long periods of time) and then the relationship ends. Perhaps the break-up is mutual, perhaps it is more one-sided, yet the fact remains that humans possess the capacity to sever romantic bonds (and to move on when the bonds have been severed). This might seem unremarkable; yet considering that in some ways falling out of love might be analogous to breaking a cocaine addiction the feat becomes a bit more compelling. Indeed, a thorough explanation of mate ejection is warranted, if for no other reason than it might yield insight into the evolution of our species. From a more pragmatic standpoint, research in this area may offer a platform from which to better understand the difficulties that can often creep into a romantic relationship. Put directly, to the extent that we better understand mate ejection, it may offer direct and actionable insight into ways in which couples can save a relationship that might otherwise come to a stultifying and abrupt halt.

## References

- Aitken, S. J., Lyons, M., & Jonason, P. K. (2013). Dads or cads? Women's strategic decisions in the mating game. *Personality and Individual Differences*, 55, 118–122. <http://dx.doi.org/10.1016/j.paid.2013.02.017>
- Alvergne, A., Faurie, C., & Raymond, M. (2009). Father–offspring resemblance predicts paternal investment in humans. *Animal Behaviour*, 78, 61–69. <http://dx.doi.org/10.1016/j.anbehav.2009.03.019>
- Aron, A., Fisher, H., Mashek, D. J., Strong, G., Li, H., & Brown, L. L. (2005). Reward, motivation, and emotion systems associated with early-stage intense romantic love. *Journal of Neurophysiology*, 94, 327–337. <http://dx.doi.org/10.1152/jn.00838.2004>
- Bailey, J. M., Gaulin, S., Agyei, Y., & Gladue, B. A. (1994). Effects of gender and sexual orientation on evolutionarily relevant aspects of human mating psychology. *Journal of Personality and Social Psychology*, 66, 1081–1093. <http://dx.doi.org/10.1037/0022-3514.66.6.1081>
- Bechara, A., Damasio, H., & Damasio, A. R. (2000). Emotion, decision making and the orbitofrontal cortex. *Cerebral Cortex*, 10, 295–307. <http://dx.doi.org/10.1093/cercor/10.3.295>
- Bechara, A., Damasio, H., Tranel, D., & Damasio, A. R. (1997). Deciding advantageously before knowing the advantageous strategy. *Science*, 275, 1293–1295. <http://dx.doi.org/10.1126/science.275.5304.1293>
- Bereczkei, T., Voros, S., Gal, A., & Bernath, L. (1997). Resources, attractiveness, family commitment; reproductive decisions in human mate choice. *Ethology*, 103, 681–699. <http://dx.doi.org/10.1111/j.1439-0310.1997.tb00178.x>
- Betzig, L. (1989). Causes of conjugal dissolution: A cross-cultural study. *Current Anthropology*, 30, 654–676. <http://dx.doi.org/10.1086/203798>
- Boelen, P. A., & Reijntjes, A. (2009). Negative cognitions in emotional problems following romantic relationship break-ups. *Stress and Health*, 25, 11–19. <http://dx.doi.org/10.1002/smi.1219>
- Borgerhoff Mulder, M. (2009). Serial monogamy as polygyny or polyandry? *Human Nature*, 20, 130–150. <http://dx.doi.org/10.1007/s12110-009-9060-x>
- Borgerhoff Mulder, M., & Schacht, R. (2012). Human behavioural ecology. *eLS*.
- Buss, D. M. (1989). Sex differences in human mate preferences: Evolutionary hypotheses tested in 37 cultures. *Behavioral and Brain Sciences*, 12, 1–49. <http://dx.doi.org/10.1017/S0140525X00023992>
- Buss, D. M. (1991). Evolutionary personality psychology. *Annual Review of Psychology*, 42, 459–491. <http://dx.doi.org/10.1146/annurev.ps.42.020191.002331>
- Buss, D. M. (1994). *The evolution of desire: Strategies for human mating*. New York, NY: Perseus.
- Buss, D. M. (1995). Evolutionary psychology: A new paradigm for psychological science. *Psychological Inquiry*, 6, 1–30. [http://dx.doi.org/10.1207/s15327965pli0601\\_1](http://dx.doi.org/10.1207/s15327965pli0601_1)
- Buss, D. M. (2000). The evolution of happiness. *American Psychologist*, 55, 15–23. <http://dx.doi.org/10.1037/0003-066X.55.1.15>
- Buss, D. M. (2004). *Evolutionary psychology*. Boston, MA: Allyn & Bacon.
- Buss, D. M., & Duntley, J. D. (2011). The evolution of intimate partner violence. *Aggression and Violent Behavior*, 16, 411–419. <http://dx.doi.org/10.1016/j.avb.2011.04.015>
- Buss, D. M., Haselton, M. G., Shackelford, T. K., Bleske, A. L., & Wakefield, J. C. (1998). Adaptations, exaptation's, and spandrels. *American Psychologist*, 53, 533–548. <http://dx.doi.org/10.1037/0003-066X.53.5.533>
- Buss, D. M., & Schmitt, D. P. (1993). Sexual strategies theory: An evolutionary perspective on human mating. *Psychological review*, 100(2), 204–232. <http://dx.doi.org/10.1037/0033-295X.100.2.204>
- Buss, D. M., & Shackelford, T. K. (1997a). From vigilance to violence: Mate retention tactics in married couples. *Journal of Personality and Social Psychology*, 72, 346–361. <http://dx.doi.org/10.1037/0022-3514.72.2.346>
- Buss, D. M., & Shackelford, T. K. (1997b). Susceptibility to infidelity in the first year of marriage. *Journal of Research in Personality*, 31, 193–221. <http://dx.doi.org/10.1006/jrpe.1997.2175>
- Cacioppo, S., Capitanio, J. P., & Cacioppo, J. T. (2014). Toward a neurology of loneliness. *Psychological Bulletin*, 140, 1464–1504. <http://dx.doi.org/10.1037/a0037618>
- Cashdan, E. (1996). Women's mating strategies. *Evolutionary Anthropology*, 5, 134–143. [http://dx.doi.org/10.1002/\(SICI\)1520-6505\(1996\)5:4<134::AID-EVAN3>3.0.CO;2-G](http://dx.doi.org/10.1002/(SICI)1520-6505(1996)5:4<134::AID-EVAN3>3.0.CO;2-G)
- Cleveland, H. H., Wiebe, R. P., van den Oord, E. J., & Rowe, D. C. (2000). Behavior problems among children from different family structures: The influence of genetic self-selection. *Child Development*, 71, 733–751. <http://dx.doi.org/10.1111/1467-8624.00182>
- Confer, J. C., Perilloux, C., & Buss, D. M. (2010). More than just a pretty face: Men's priority shifts toward bodily attractiveness in short-term versus long-term mating contexts. *Evolution and Human Behavior*, 31, 348–353. <http://dx.doi.org/10.1016/j.evolhumbehav.2010.04.002>
- Connolly, C. G., Bell, R. P., Foxe, J. J., & Garavan, H. (2013). Dissociated grey matter changes with prolonged addiction and extended abstinence in cocaine users. *PLoS ONE*, 8, e59645. <http://dx.doi.org/10.1371/journal.pone.0059645>
- Daly, M., & Wilson, M. (1983). *Sex, evolution, and behavior* (2nd ed.). Belmont, CA: Wadsworth.
- Daly, M., & Wilson, M. (1988). *Homicide*. New York, NY: Aldine de Gruyter.
- Darwin, C. (1859). *On the origin of species*. London, United Kingdom: John Murray.
- Darwin, C. (1871). *The descent of man and selection in relation to sex*. New York, NY: The Modern Library/Random House. <http://dx.doi.org/10.1037/12293-000>
- Dawkins, R. (1976). *The selfish gene*. New York, NY: Oxford University Press.
- DeSteno, D., Bartlett, M. Y., Braverman, J., & Salovey, P. (2002). Sex differences in jealousy: Evolutionary mechanism or artifact of measurement? *Journal of Personality and Social Psychology*, 83, 1103–1116. <http://dx.doi.org/10.1037/0022-3514.83.5.1103>
- Dugan, L., Nagin, D. S., & Rosenfeld, R. (1999). Explaining the decline in intimate partner homicide. *Homicide Studies*, 3, 187–214. <http://dx.doi.org/10.1177/1088767999003003001>
- Ellis, L. (1995). Dominance and reproductive success among nonhuman animals: A cross-species comparison. *Ethology and Sociobiology*, 16, 257–333. [http://dx.doi.org/10.1016/0162-3095\(95\)00050-U](http://dx.doi.org/10.1016/0162-3095(95)00050-U)



- Eysenck, H. J. (1980). Personality, marital satisfaction, and divorce. *Psychological Reports*, 47, 1235–1238. <http://dx.doi.org/10.2466/pr0.1980.47.3f.1235>
- Fisher, H. E., Aron, A., & Brown, L. L. (2006). Romantic love: A mammalian brain system for mate choice. *Philosophical Transactions of the Royal Society of London Series B: Biological Sciences*, 361, 2173–2186. <http://dx.doi.org/10.1098/rstb.2006.1938>
- Fisher, H. E., Aron, A., Mashek, D., Li, H., & Brown, L. L. (2002). Defining the brain systems of lust, romantic attraction, and attachment. *Archives of Sexual Behavior*, 31, 413–419. <http://dx.doi.org/10.1023/A:1019888024255>
- Fisher, H. E., Brown, L. L., Aron, A., Strong, G., & Mashek, D. (2010). Reward, addiction, and emotion regulation systems associated with rejection in love. *Journal of Neurophysiology*, 104, 51–60. <http://dx.doi.org/10.1152/jn.00784.2009>
- Fisher, H. E., & Thomson, J. A. (2007). Lust, romance, attachment: Do the side effects of serotonin-enhancing antidepressants jeopardize romantic love, marriage, and fertility? In S. M. Platek, J. P. Keenan, & T. Shackelford (Eds.), *Evolutionary cognitive neuroscience* (pp. 245–284). Cambridge, MA: MIT Press.
- Griffin-Shelley, E. (1991). *Sex and love: Addiction, treatment and recovery*. Westport, CT: Praeger.
- Harris, C. R. (2002). Sexual and romantic jealousy in heterosexual and homosexual adults. *Psychological Science*, 13, 7–12. <http://dx.doi.org/10.1111/1467-9280.00402>
- Harris, C. R. (2003). A review of sex differences in sexual jealousy, including self-report data, psychophysiological responses, interpersonal violence, and morbid jealousy. *Personality and Social Psychology Review*, 7, 102–128. [http://dx.doi.org/10.1207/S15327957PSPR0702\\_102-128](http://dx.doi.org/10.1207/S15327957PSPR0702_102-128)
- Hurtado, A. M., & Hill, K. R. (1992). Paternal effect on offspring survivorship among Ache and Hiwi hunter-gatherers: Implications for modeling pair-bond stability. *Father-Child Relations: Cultural and Biosocial Contexts*, 31–55.
- Jocklin, V., McGue, M., & Lykken, D. T. (1996). Personality and divorce: A genetic analysis. *Journal of Personality and Social Psychology*, 71, 288–299. <http://dx.doi.org/10.1037/0022-3514.71.2.288>
- Klinkova, E., Hodges, J. K., Fuhrmann, K., de Jong, T., & Heistermann, M. (2005). Male dominance rank, female mate choice and male mating and reproductive success in captive chimpanzees. *International Journal of Primatology*, 26, 357–484. <http://dx.doi.org/10.1007/s10764-005-2929-6>
- Mackey, S., & Paulus, M. (2013). Are there volumetric brain differences associated with the use of cocaine and amphetamine-type stimulants? *Neuroscience and Biobehavioral Reviews*, 37, 300–316. <http://dx.doi.org/10.1016/j.neubiorev.2012.12.003>
- Marlowe, F. W. (2004). Mate preferences among Hadza hunter-gatherers. *Human Nature*, 15, 365–376. <http://dx.doi.org/10.1007/s12110-004-1014-8>
- Mealey, L. (2000). *Sex differences: Developmental and evolutionary strategies*. San Diego, CA: Academic Press.
- Meloy, J. R., & Fisher, H. (2005). Some thoughts on the neurobiology of stalking. *Journal of Forensic Sciences*, 50, 1472–1480. <http://dx.doi.org/10.1520/JFS2004508>
- Miller, G. (2000). *The mating mind: How sexual choice shaped the evolution of human nature*. New York, NY: Doubleday.
- Mulder, M. B. (1990). Kipsigis women's preferences for wealthy men: Evidence for female choice in mammals? *Behavioral Ecology and Sociobiology*, 27, 255–264. <http://dx.doi.org/10.1007/BF00164897>
- Murdock, G. P. (1967). *Ethnographic atlas*. Pittsburgh, PA: University of Pittsburgh Press.
- Najib, A., Lorberbaum, J. P., Kose, S., Bohning, D. E., & George, M. S. (2004). Regional brain activity in women grieving a romantic relationship breakup. *The American Journal of Psychiatry*, 161, 2245–2256. <http://dx.doi.org/10.1176/appi.ajp.161.12.2245>
- Palmer, C. T. (1991). Human rape: Adaptation or by-product? *Journal of Sex Research*, 28, 365–386. <http://dx.doi.org/10.1080/00224499109551614>
- Pawłowski, B., & Dunbar, R. I. (1999). Impact of market value on human mate choice decisions. *Proceedings of the Royal Society of London, Series B: Biological Sciences*, 266, 281–285. <http://dx.doi.org/10.1098/rspb.1999.0634>
- Penke, L., Denissen, J. J. A., & Miller, G. F. (2007). The evolutionary genetics of personality. *European Journal of Personality*, 21, 549–587. <http://dx.doi.org/10.1002/per.629>
- Pinker, S. (1997). *How the mind works*. New York, NY: Norton.
- Platek, S. M., & Shackelford, T. K. (Eds.). (2006). *Female infidelity and paternal uncertainty: Evolutionary perspectives on male anti-cuckoldry tactics*. New York, NY: Cambridge University Press. <http://dx.doi.org/10.1017/CBO9780511617812>
- Rasmussen, D. R. (1981). Pair-bond strength and stability and reproductive success. *Psychological Review*, 88(3), 274–290. <http://dx.doi.org/10.1037/0033-295X.88.3.274>
- Ridley, M. (1993). *The red queen: Sex and the evolution of human nature*. New York, NY: Putnam.
- Sagarin, B. J., Vaughn Becker, D., Guadagno, R. E., Nicastle, L. D., & Millevoi, A. (2003). Sex differences (and similarities) in jealousy: The moderating influence of infidelity experience and sexual orientation of the infidelity. *Evolution and Human Behavior*, 24, 17–23. [http://dx.doi.org/10.1016/S1090-5138\(02\)00106-X](http://dx.doi.org/10.1016/S1090-5138(02)00106-X)
- Schoen, R., Astone, N. M., Kim, Y. J., Rotherth, K., & Standish, N. J. (2002). Women's employment, marital happiness, and divorce. *Social Forces*, 81, 643–662. <http://dx.doi.org/10.1353/sof.2003.0019>
- Shackelford, T. K., Buss, D. M., & Bennett, K. (2002). Forgiveness or breakup: Sex differences in responses to a partner's infidelity. *Cognition and Emotion*, 16, 299–307. <http://dx.doi.org/10.1080/02699930143000202>
- Symons, D. (1979). *The evolution of human sexuality*. New York, NY: Oxford University Press.
- Thornhill, R., & Palmer, C. T. (2001). *A natural history of rape: Biological bases of sexual coercion*. Cambridge, MA: MIT Press.
- Tooby, J., & Cosmides, L. (1990). On the universality of human nature and the uniqueness of the individual: The role of genetics and adaptation. *Journal of Personality*, 58, 17–67. <http://dx.doi.org/10.1111/j.1467-6494.1990.tb00907.x>
- Tooby, J., & Cosmides, L. (1992). Psychological foundations of culture. In J. H. Barkow, L. Cosmides, & J. Tooby (Eds.), *The adapted mind* (pp. 19–136). New York, NY: Oxford University Press.
- Treas, J., & Giesen, D. (2000). Sexual infidelity among married and cohabiting Americans. *Journal of Marriage and the Family*, 62, 48–60. <http://dx.doi.org/10.1111/j.1741-3737.2000.00048.x>
- Turkheimer, E. (2000). Three laws of behavior genetics and what they mean. *Current Directions in Psychological Science*, 9, 160–164. <http://dx.doi.org/10.1111/1467-8721.00084>
- Williams, G. C. (1966). *Adaptation and natural selection: A critique of some current evolutionary thoughts*. Princeton, NJ: Princeton University Press.
- Wright, R. (1994). *The moral animal: Why we are the way we are: The new science of evolutionary psychology*. New York, NY: Random House.

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