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THE TYRANNY OF LOVE:

Love addiction--an anthropologist's view

"When we want to read of the deeds of love,
whither do we turn? To the murder column."

-- *George Bernard Shaw*

Laymen and scientists have long regarded romantic love as part of the supernatural, or as an invention of the Troubadours in 12th century France, or as the result of cultural tradition. However, current data collected using brain scanning (functional magnetic resonance imaging or fMRI) indicate that feelings of intense romantic love engage regions of the brain's "reward system," specifically dopamine pathways associated with energy, focus, motivation, ecstasy and craving, including primary regions associated with addiction (Bartels and Zeki 2000; Fisher et al 2003; Bartels and Zeki 2004; Aron et al 2005; Fisher et al 2005; Ortigue et al 2007; Fisher et al 2010a; Acevedo et al., 2011, Xu et al 2011). Moreover, men and women who are passionately in love show all of the basic symptoms of addiction, including craving, tolerance, emotional and physical dependence, withdrawal and relapse (see Fisher 2004).

Because romantic love is regularly associated with a suite of traits linked with all addictions, several psychologists have come to believe that romantic love can potentially *become* an addiction (Peele 1975; Halpern 1982; Tennov 1979; Hunter et al 1981; Mellody et al 1992; Griffin-Shelley 1991; Schaef 1989). However, many define addiction as a pathological, problematic disorder (Reynaud et al 2010); and because romantic love is a positive experience under many circumstances (i.e. not harmful), researchers remain largely unwilling to officially categorize romantic love *as* an addiction.

But even when romantic love can't be regarded as harmful, it is associated with intense craving and anxiety and can impel the lover to believe, say and do dangerous and inappropriate things. Moreover, all forms of substance abuse, including alcohol, opioids, cocaine, amphetamines, cannabis, and tobacco activate reward pathways (Volkow et al., 2007; Diana 2013; Koob and Volkow 2010; Melis et al., 2005; Frascella et al., 2010; Breiter et al 1997), and several of these same reward pathways are also found to be activated among men and women who are happily in love, as well as those rejected in love (Bartels and Zeki 2000; Fisher et al 2003; Bartels and Zeki 2004; Aron et al 2005; Fisher et al 2005; Ortigue et al 2007; Fisher et al 2010; Acevedo et al., 2011, Xu et al 2011). So regardless of its official diagnostic classification, I believe romantic love should be *treated* as an addiction (Fisher 2004): a *positive* addiction when one's love is reciprocated, non-toxic and appropriate (i.e. neither partner is married to someone else or has other inappropriate lifestyle issues); and a *negative* addiction when one's feelings of romantic love are inappropriate, toxic, not reciprocated and/or formally rejected (Fisher 2004).

This chapter maintains that romantic love is a *natural* addiction (Brown, in Frascella et al., 2010) that evolved from mammalian antecedents at the basal radiation of the hominid clade some 4.4 million years ago in conjunction with the evolution of serial social monogamy and clandestine adultery--hallmarks of the human reproductive strategy (Fisher 1998; Fisher 2004; Fisher 2011). Its purpose was to motivate our forebears to focus their mating time and energy on a single partner at a time, thus initiating the formation of a pair-bond to rear their young together as a team (Fisher 1992; Fisher 1998; Fisher et al., 2006, Fisher 2011). The chapter discusses the traits associated with both positive and negative love addiction; it traces the evolution of love addictions to their likely origins; it proposes a theory for the biopsychological foundations of different types of love addiction; and it offers some scientifically-based suggestions for treatment of individuals suffering from rejection addiction.

ROMANTIC LOVE AS A POSITIVE ADDICTION

Human romantic love, also known as passionate love, obsessive love, and "being in love," is a cross-cultural phenomenon. In a survey of 166 societies, Jankowiak and Fischer (1992) found evidence of romantic love in 147 of them. No negative evidence was found; in the 19 remaining cultures, anthropologists had failed to ask the appropriate questions. Jankowiak and Fischer concluded that romantic love constitutes a human universal, or near universal phenomenon (Jankowiak and Fischer 1992).

Romantic attraction is associated with a suite of psychological, behavioral and physiological traits (Liebowitz 1983; Fisher 1998; Hatfield et al. 1988; Hatfield and Sprecher 1986; Harris 1995; Tennov 1979). This passion begins as the lover starts to regard the beloved as special and unique; the beloved takes on "special meaning." The lover focuses his/her

attention on the beloved (saliency), as well as aggrandizes the beloved's better traits while overlooking or minimizing their flaws. The lover expresses increased energy (hypomania), as well as ecstasy when the love affair is going well, mood swings into despair (and anhedonia) when problems in the relationship arise, and often general anxiety about their role, how to please and how to achieve their goal: union with the beloved. Adversity and social barriers heighten romantic passion and craving (frustration attraction). The lover suffers when apart from the beloved (separation anxiety), as well as expressing one or more sympathetic nervous system reactions when with the beloved, including sweating, stammering, butterflies in the stomach, a pounding heart and/or difficulty eating or sleeping: the lover is emotionally and physically dependent. They also distort reality, change their priorities and daily habits to accommodate the beloved, experience personality changes (affect disturbance) and sometimes do inappropriate or dangerous things to remain in contact with or impress this special other.

Smitten humans also exhibit increased empathy for the beloved; many are willing to sacrifice, even die for him or her. They can become jealous if they suspect others are jeopardizing the budding partnership, as well as intensely socially and sexually possessive, (mate guarding)(Buss 2000). Lovers also express intense sexual desire for the beloved; yet their yearning for emotional union tends to overshadow their craving for sexual union with him or her. Most characteristic, the lover thinks obsessively about the beloved (intrusive thinking). They may also compulsively follow, incessantly call, write or unexpectedly appear, all in an effort to be with their beloved day and night. Paramount to this experience is intense motivation to win him or her. Romantic attraction is also involuntary and difficult to control.

Moreover, besotted men and women express all of the four basic traits of addiction: craving, tolerance (intensification), withdrawal symptoms and relapse. Like all addicts, they

yearn for the beloved (craving) and feel a "rush" of exhilaration when thinking about him or her (intoxication). As their tolerance builds, the lover seeks to interact with the beloved more and more frequently. If the beloved breaks off the relationship, the lover experiences the common signs of drug withdrawal, too, including protest, crying spells, lethargy, anxiety, insomnia or hypersomnia, loss of appetite or binge eating, irritability and chronic loneliness. Like most addicts, rejected lovers also often go to extremes, even sometimes doing degrading or physically dangerous things to win back the beloved. Lovers also relapse the way drug addicts do: long after the relationship is over, events, people, places, songs or other external cues associated with their abandoning sweetheart can trigger memories and initiate renewed craving, obsessive thinking and/or compulsive calling, writing or showing up in hopes of rekindling the romance--despite what they suspect may lead to adverse consequences.

Several neuroimaging studies of romantic love indicate the physiological underpinnings of this universal or near-universal human experience (Bartels and Zeki 2000; Fisher et al., 2003; Bartels and Zeki 2004; Fisher et al., 2005; Aron et al., 2005; Ortigue et al., 2007; Fisher et al., 2010a; Acevedo et al., 2011; Xu et al., 2011). In our first experiment (Fisher et al 2003; Fisher et al., 2005; Aron et al., 2005;), we used functional magnetic resonance imaging (fMRI) to study 10 women and 7 men who had recently fallen intensely and happily in love. All scored high on the Passionate Love Scale (Hatfield and Sprecher 1986), a self-report questionnaire that measures the intensity of romantic feelings; all participants also reported that they spent more than 85% of their waking hours thinking of their beloved.

Participants alternately viewed a photograph of their sweetheart and a photograph of a familiar individual, interspersed with a distraction-attention task. Group activation occurred in several regions of the brain's reward system, including the ventral tegmental area (VTA) and

caudate nucleus (Fisher et al., 2003; Fisher et al., 2005; Aron et al., 2005), regions associated with pleasure, general arousal, focused attention and motivation to pursue and acquire rewards and mediated primarily by dopamine system activity (Schultz 2000; Delgado et al., 2000; Elliot et al., 2003), as well as the insula, a brain region associated with anxiety. Moreover, in a principle component analysis on these 17 men and women, we found evidence suggesting that activity in the nucleus accumbens and prefrontal cortex co-varied (unpublished data). These regions of the reward system are directly associated with addiction in many studies of drugs of abuse (Volkow et al., 2007; Diana 2013; Koob and Volkow 2010; Melis et al., 2005; Frascella et al., 2010; Panksepp et. al. 2002; Breiter et al., 1997).

Our second fMRI investigation studied 17 men and women in their 50s and 60s who were married an average of 21 years and reported that they still felt the "high" of early stage intense romantic love. This study also showed group activation in the VTA, the nucleus accumbens and other regions of the reward system (Acevedo et al., 2011). Further, in another study of "in love" men and women, Bartels and Zeki (2000) compared the brain scans of their love-struck individuals with those who were experiencing euphoria following injections of cocaine or opioids; many of the same regions of the reward system also became active.

These data from several studies indicate that individuals who are happily in love express activity in neural regions associated with drug addiction.

ROMANTIC REJECTION AS A NEGATIVE ADDICTION

Cross-culturally, few men or women are able to avoid suffering from romantic rejection at some point over their lives. In one American college community, 93% of both sexes queried reported that they had been spurned by someone whom they passionately loved; 95% reported they had rejected someone who was deeply in love with

them (Baumeister et al., 1993). Romantic rejection causes a profound sense of loss and negative affect. It can induce clinical depression, and in extreme cases lead to suicide and/or homicide. Some broken-hearted lovers even die from heart attacks or strokes caused by their depression (Rosenthal 2000).

To identify some of these neural systems associated with this natural loss state, my colleagues and I used functional magnetic resonance imaging (fMRI) to study 10 women and 5 men who had recently been rejected by a partner, but reported that they were still intensely "in love" (Fisher et al 2010a). The average length of time since the initial rejection and the participants' enrollment in the study was 63 days. All scored high on the Passionate Love Scale (Hatfield and Sprecher 1986), a self-report questionnaire that measures the intensity of romantic feelings. All participants also said that they spent more than 85% of their waking hours thinking of the person who rejected them; and all yearned for their abandoning partner to return to the relationship.

Participants alternately viewed a photograph of their rejecting partner and a photograph of a familiar, emotionally neutral individual, interspersed with a distraction-attention task. Their responses while looking at their rejecter in the scanner included feelings of romantic passion, despair, joyous and painful memories, rumination about why this had happened, and mental assessments of their gains and losses from the experience. Brain activations coupled with romantic rejection occurred in several regions of the brain's reward system. Included were: the ventral tegmental area (VTA) associated with feelings of intense romantic love; the ventral pallidum associated with feelings of attachment; the insular cortex and the anterior cingulate associated with physical pain, anxiety and the distress associated with physical pain; and the nucleus

accumbens and orbitofrontal/prefrontal cortex associated with assessing one's gains and losses, as well as craving and addiction (Fisher et al., 2010a). As noted above, activity in several of these brain regions has been correlated with craving in cocaine addicts and other drugs of abuse (Diana 2013; Koob and Volkow 2010; Melis et al., 2005; Frascella et al., 2010).

Romantic rejection has several biolpsychological components that most likely contribute to the intensity of this *negative* natural addiction.

I. PROTEST

Psychiatrists divide romantic rejection into two general stages (Lewis Amini and Lannon 2000; Fisher 2004). During the *Protest Phase*, the deserted lover obsessively tries to win back the beloved. As *Resignation/Despair* sets in, the lover gives up hope and slips into despair.

During the *Protest Phase* rejection addiction may become the most intense, because psychiatrists Lewis, Amini and Lannon (2000) propose that the *Protest Phase* is associated with elevated activity of the dopamine system, as well as with the closely related norepinephrine system. Moreover, they assert that the *Protest Phase* of human romantic rejection stems from a basic mammalian mechanism that becomes active when *any* kind of social attachment is ruptured. The example they give is the puppy that is removed from mother and put into the kitchen by itself. Immediately it begins to pace, frantically leaping at the door, barking and whining in protest. Isolated baby rats emit ceaseless ultrasonic cries; they hardly sleep because their brain arousal is so intense (Panksepp 1998). So these psychiatrists believe that changes in the activities of these catecholamines is an adaptive mechanism that evolved to increase alertness and stimulate abandoned baby mammals to protest, search, and call for help.

Accompanying this protest is stress, which also elevates dopamine system activity. When mammals first experience severe stress, among their bodily reactions is an increase in the activity of the central dopamine and norepinephrine systems and a suppression of central serotonin, known as the "*stress response*"(Kapit , Macey, and Meisami 2000). So this "stress response" during the *Protest Phase* of romantic rejection could potentially sustain or intensify the addictive thoughts and behaviors of romantically rejected lovers.

Rejection may trigger another brain response likely to sustain or intensify rejection addiction, known as "*frustration-attraction*"(Fisher 2004:16). When lovers encounter barriers to their romantic feelings, their passion often intensifies: adversity heightens romantic love. Frustration-attraction most likely also has biological foundations. When a reward is delayed in coming, neurons of the brain's reward system sustain their activation (Schultz 2000)—sustaining the activity of central dopamine and thus rejection addiction.

During the *Protest Phase* of rejection, both men and women can also exhibit "*frustration aggression*," known to psychologists as "*abandonment rage*"(Meloy 2001; Meloy 1998). Even when a rejecting partner departs with compassion and graciously honors his or her responsibilities as a friend or co-parent, many rejected people often oscillate between feelings of heartbreak and fury. This response also has neural correlates. The primary rage system is closely connected to centers in the prefrontal cortex that anticipate rewards (Panksepp 1998). As a result, Lewis, Amini and Lannon (2000) propose that when a human or other mammal begins to realize that an expected reward is in jeopardy, even unattainable, these regions of the prefrontal cortex stimulate the amygdala and trigger rage (Panksepp 1998). This rage response to unfulfilled expectations is well known in mammals. When a cat's brain circuits for reward are

artificially stimulated, it expresses pleasure. When this pleasurable stimulation is withdrawn, it bites.

Romantic passion and abandonment rage have much in common. Both are associated with bodily and mental arousal; both produce obsessive thinking, focused attention, motivation and goal-directed behaviors; and both cause intense yearning--either for union with or fury at the beloved (Fisher 2004; Meloy and Fisher 2005). Moreover, love and rage can act in tandem. In a study of 124 dating couples, Ellis and Malamuth (2000) reported that romantic love and "anger/upset" react to different kinds of information. The lover's level of anger/upset oscillate in response to events that undermine the lover's goals, such as a mate's infidelity, lack of emotional commitment and/or rejection. The lover's feelings of romantic love fluctuate, instead, in response to events that advance the lover's goals, such as a partner's visible social support during outings with relatives and friends or direct declaration of love and fidelity. Thus, romantic love and anger/upset can operate concurrently, adding complexity and intensity to the expression of rejection addiction.

Another biological system may add to the complex addictive response of the rejected lover: jealousy. Romantic jealousy is common cross-culturally (Meloy 1998; Meloy and Fisher 2005; Buss 2000), and it regularly leads to intense possessiveness of a mating partner. This possessiveness is so common in other mammalian and avian species that ethologists refer to it as mate guarding (Buss 2000). The biological correlates of human mate-possessiveness are unknown. Data from studies of prairie voles, a pair-bonding species, suggest that vasopressin is one of the neurochemical systems likely to be involved in mate guarding (Young et al., 1998). Undoubtedly many brain systems

contribute to human jealousy. Regardless, this complex neural system for jealousy and mate guarding most likely contributes to the obsessive thoughts and inappropriate behaviors of those suffering from rejection addiction.

In fact, the above suite of negative biologically-based phenomena associated with rejection in love, including protest, the stress response, frustration attraction, abandonment rage, jealousy and mate guarding--in conjunction with craving and withdrawal symptoms—most likely lead to the high worldwide incidence of crimes of passion (see Meloy 1998; Meloy and Fisher 2005). Like many addictions, romantic love can lead to violence and criminality. Like many addictions, it can also jeopardize one's health, because abandonment rage stresses the heart, raises blood pressure and suppresses the immune system (Dozier 2002).

II. **RESIGNATION / DESPAIR**

Eventually, the abandoned lover ceases his or her pursuit of the beloved. This second general phase of romantic rejection, *Resignation/Despair* (Lewis, Amini and Lannon 2000), is less likely to be an addiction, but instead, an artifact of addiction. During this stage, the abandoned lover slips into feelings of resignation, despair, lethargy, despondency, melancholy and depression (Najib et al., 2004; Panksepp 1998), known as the "*despair response*" (Panksepp 1998; Lewis, Amini and Lannon 2000; Fisher 2004). In a study of 114 men and women who had been rejected by a partner within the past eight weeks, 40% experienced clinically measurable depression (Mearns 1991). People can also die of a broken heart, either from myocardial infarctions or cerebral vascular accidents caused by their depression (Nemeroff 1998; Rosenthal 2002).

This feeling of despair has been associated with several different brain networks, including reduced activity in the dopamine reward system. As a depressed mammal comes to believe a reward will never come, the dopamine-producing cells in the reward system decrease their activity (Schultz 2000). Diminishing activity of central dopamine produces lethargy, despondency and depression (Panksepp 1998). Stress contributes to this despair response. Short-term stress activates the production of dopamine and norepinephrine. But as stress continues, it suppresses the activity of these catecholamines—-producing depression (Panksepp 1998; Kapit et al., 2000).

Humans express a constellation of powerful neural systems designed to enable men and women to doggedly pursue specific mating partners, protest desertion and suffer profound emotional and physical responses at abandonment. Why has *Homo sapiens* evolved this intense positive addiction to a potential mating partner and this dangerous negative addiction to a rejecting mate?

EVOLUTION OF ROMANTIC ADDICTIONS

It is likely that the neural systems associated with feelings of intense *positive* romantic addiction to a beloved evolved in conjunction with the evolution of the human predisposition for pair-bonding, serving as a mechanism to stimulate mate choice and motivate individuals to remain with a mate long enough to breed and rear their offspring through infancy as a team.

Pair-bonding is a hallmark of humanity. Data from the Demographic Yearbooks of the United Nations on 97 societies canvassed in the 1980s indicate that approximately 93.1% of women and 91.8% of men in that decade married by age 49 (Fisher 1989; Fisher, 1992). Worldwide marriage rates have declined since then; but today 85% to 90% of men and women in the United States are projected to marry (Cherlin 2009). Cross-culturally, most individuals

are monogamous; they wed one person at a time. Polygyny (many females) is permitted in 84% of human societies; but in the vast majority of these cultures, only 5% to 10% of men actually have several wives simultaneously (Frayser, 1985; van den Berghe, 1979). Moreover, because polygyny in humans is regularly associated with rank and wealth, monogamy may have been even more prevalent in prehorticultural, unstratified societies (Daly and Wilson 1983) when the neural systems for positive (and negative) love addictions most likely evolved. (Polyandry, or many males, is permitted in less than 0.5% of societies on record and is not considered a central aspect of our basic human reproductive strategy).

Several data suggest that the human predisposition for pair-bonding has a biological basis. The investigation of human attachment began with Bowlby (Bowlby 1969; 1973) and Ainsworth (Ainsworth et al., 1978) who proposed that, to promote the survival of the young, primates have evolved an innate attachment system designed to motivate infants to seek comfort and safety from their primary caregiver, generally the mother. Since these early studies, extensive research has been done on the behaviors, feelings and neural mechanisms associated with this attachment system in adult humans and other animals (Fraley and Shaver 2000; Panksepp 203a; Panksepp 203b; Tucker et. al. 2005; MacDonald and Leary 2005; Eisenberger et. al. 2003). Currently, researchers believe that this biologically-based attachment system remains active throughout the human life course, serving as the foundation for attachment between pair-bonded spouses for the purpose of raising offspring (Hazan and Diamond 2000; Hazan and Shaver 1987). Hatfield refers to the human feelings associated with these attachment behaviors as "*companionate love*," which she defines as "a feeling of happy togetherness with

someone whose life has become deeply entwined with yours." (Hatfield et al., 1988:p.191).

The human penchant to form a pair-bond is rare among mammals; only 3% form pair-bonds to rear their young (Mock and Fujioka 1990; Wittenberger and Tilson 1980). But pair-bonding is common in avian species; some 90% of more than 8,000 avian species practice pair-bonding to rear their young (Mock and Fujioka 1990; Wittenberger and Tilson 1980). And in all avian and mammalian species where monogamy is the primary reproductive strategy, it is associated with a particular group of behaviors, including mutual territory defense and/or nest building, mutual feeding and grooming, maintenance of close proximity, affiliative behaviors and shared parental chores. Moreover, these behaviors are associated primarily with oxytocin and vasopressin activity in the nucleus accumbens and ventral pallidum, respectively (Lim et al., 2004; Lim and Young 2004). The most informative biological research has been collected on prairie voles. These individuals mate soon after puberty and maintain a monogamous relationship throughout their life course, raising a series of litters as a team. When prairie voles engage in sex, copulation triggers the activity of oxytocin in the nucleus accumbens among females and arginine vasopressin in the ventral pallidum among males, which then facilitates dopamine release in these reward regions and motivates females and males to prefer a particular mating partner, initiate pair-bonding and express attachment behaviors toward one another (Gingrich et al 2000; Lim, et al., 2004; Carter 1992; Lim and Young, 2004).

These data are corroborated in other species. Promiscuous white-footed mice and promiscuous rhesus monkeys do not form pair-bonds or express attachment behaviors toward a

specific mate, and the males of these species do not express the same distribution of vasopressin receptors in the ventral pallidum (Bester-Meredith et al., 1999; Wang et al., 1997; Young, 1999; Young et al., 1998). Moreover, when scientists (Pitkow et al 2001; Lim and Young 2004) transgenically inserted the genetic variant in the vasopressin system associated with pair-bonding in male prairie voles into the ventral pallidum of male meadow voles, an asocial promiscuous species, vasopressin receptors were up-regulated; these males also began to fixate on a particular female and mate exclusively with her, even when other females were available (Lim et al., 2004). When this gene was inserted into non-monogamous male mice, these creatures also began to exhibit attachment behaviors (Young et al., 1999). Activity in the ventral pallidum has also been linked with longer-term pair-bonding in humans (Acevedo et al., 2011). Although the vasopressin gene(s) in *Homo sapiens* are not homologous to the one(s) found in prairie voles, humans do have similar alleles in this genetic region (Walum et al., 2008), suggesting that a related biological system plays a role in human pair-bonding.

More important to this chapter, in our studies of individuals who are happily in love (Fisher et al., 2003; Aron et al., 2005; Fisher et al., 2005), we found that those in longer partnerships (8-17 months as opposed to 1-8 months) began to show activity in the ventral pallidum (associated with feelings of attachment), while continuing to show activity in the VTA and caudate nucleus associated with passionate romantic love. Thus, with time, feelings of attachment begin to *accompany* feelings of romantic love. Working in conjunction, these two basic neural systems for romantic love and attachment may constitute the biological foundations of human pair-bonding—and provide the context for the evolution of love addictions.

Pair-bonding could have evolved at any point in hominid evolution, and with it, various love addictions. However, two lines of data suggest that the neural circuitry for human pair-

bonding may have evolved at the basal radiation of the hominid stock (Fisher 1992; Fisher 2011), in tandem with the hominid adaptation to the woodland/savannah eco-niche some time prior to 4 million years BP. *Ardipithecus ramidus*, currently dated at 4.4 million years BP, displays several sexually dimorphic physical traits that have been linked with pair-bonding in many species; so Lovejoy (2009) proposes that human monogamy had evolved by this time. Anthropologists have also re-measured *Australopithicus afarensis* fossils for skeletal variations; and they report that by 3.5 million years BP hominids exhibited roughly the same degree of sexual dimorphism in several physical traits that the sexes exhibit today. Thus, they have proposed that these hominids were "principally monogamous" (Reno et al 2003:1073).

The emergence of bipedalism may have been a primary factor in the evolution of the neural circuitry for hominid pair-bonding (Fisher 1992; Fisher 2011) and concomitant evolution of romantic love (and attachment) addictions. While foraging and scavenging in the woodland/savannah eco-niche, bipedal Ardipithecine females were most likely obliged to carry infants in their arms instead of on their backs, thus needing the protection and provisioning of a mate while they transported nursing young. Meanwhile, Ardipithecine males may have had considerable difficulty protecting and providing for a harem of females in this open woodland/savannah eco-niche. But a male could defend and provision a single female with her infant as they walked near one another, within the vicinity of the larger community.

So the exigencies of bipedalism in conjunction with hominid expansion into the woodland/savannah eco-niche may have pushed Ardipithecines over the "*monogamy threshold,*" selecting for the neural systems for attachment to a pair-bonded partner. And

along with the evolution of pair-bonding and the neural systems for attachment may have emerged the brain system for intense positive romantic addiction—serving to motivate males and females to focus their mating energy on a single partner and remain together long enough to trigger feelings of attachment necessary to initiate and complete their co-parenting duties of highly infantile young (Fisher 1992; 2004, Fisher 2011).

Considerable data suggest that the human brain system for romantic love arose from mammalian antecedents. Like humans, all birds and mammals exhibit mate preferences; they focus their courtship energy on favored potential mates and disregard or avoid others (Fisher 2004; Fisher et al., 2006). This phenomenon is so common that the ethological literature regularly uses several terms to describe it, including "female choice," "mate preference," "individual preference," "favoritism," "sexual choice," "female choice," "selective proceptivity" (Andersson 1994) and "courtship attraction" (Fisher 2004). Further, most of the basic traits associated with human romantic love are also characteristic of mammalian courtship attraction, including increased energy, focused attention, obsessive following, affiliative gestures, possessive mate guarding, goal-oriented behaviors and motivation to win and keep a preferred mating partner for the duration of one's species-specific needs (Fisher et al 2002; Fisher 2004; Fisher et al., 2006).

The brain system for human romantic love also shows similarities with mammalian neural systems for courtship attraction. When a female laboratory–maintained prairie vole is mated with a male, she forms a distinct preference for him, associated with a 50% increase of dopamine in the nucleus accumbens (Gingrich et al., 2000). When a dopamine antagonist is injected into the nucleus accumbens, the female no longer prefers this partner. And when a female is injected with a dopamine agonist, she begins to prefer the

conspecific (member of the same species) who is present at the time of the infusion, even if she has not mated with this male (Gingrich et al., 2000; Wang et al., 1999). An increase in the activities of central dopamine is also associated with courtship attraction in female sheep (Fabre-Nys et al., 1997). In male rats, increased striatal dopamine release has also been shown in response to the presence of a receptive female rat (Montague et al. 2004; Robinson et al. 2002).

Because human romantic love shares many behavioral and biological characteristics with mammalian courtship attraction, it is likely that human romantic love is a developed form of this mammalian neural courtship mechanism (Fisher 1998; Fisher 2004). However in most species, courtship attraction is brief, lasting only minutes, hours, days or weeks; while in humans, intense, early-stage romantic love can last 12 to 18 months (Marazziti et al., 1999) or much longer (Acevedo et al., 2011). So activity in the mammalian neural system for courtship attraction may have become intensified and prolonged as hominid pair-bonding evolved, becoming the positive romantic addiction experienced by happily-in-love men and women around the world today.

Two artifacts of human pair-bonding, however, may have contributed to *negative* romantic addictions: the human predisposition for infidelity; and the human predisposition for divorce. Both contribute to partnership instability and the likelihood of rejection addiction.

INFIDELITY INTENSIFIES REJECTION ADDICTION

Monogamy is only part of the human reproductive strategy. Infidelity is also widespread (Buunk & Dijkstra, 2006; Fisher, 1992; see Tsapelas, Fisher and Aron, 2010). The National Opinion Research Center in Chicago reports that some 25% of American men and 15% of

American women philander at some point during marriage (Laumann et al.,1994). Other studies of American married couples indicate that 20%-40% of heterosexual married men and 20%-25% of heterosexual married women have an extramarital affair during their lifetime (Greeley, 1994; Laumann et al., 1994; Tafoya & Spitzberg 2007). Still others indicate that some 30% to 50% of American married men and women are adulterous (Gangestad and Thornhill 1997).

The Oxford English Dictionary defines adultery as sexual intercourse by a married person with someone other than one's spouse. But researchers have broadened this definition to include sexual infidelity (sexual exchange with no romantic involvement), romantic infidelity (romantic exchanges with no sexual involvement) and sexual and romantic involvement (Glass & Wright, 1992). When considering these varieties of adultery, statistics vary. In a meta-analysis of 12 studies of infidelity among American married couples, Thompson (1983) reported that 31% of men and 16% of women had had a sexual affair that entailed no emotional involvement; 13% of men and 21% of women had been romantically but not sexually involved with someone other than their spouse; and 20% of men and women had engaged in an affair that included both a sexual and emotional connection. Currently 70% of American dating couples report an incidence of infidelity in their partnership (Allen & Baucom, 2006). Infidelity was also widespread in former decades, as well as in all other human societies and all mammalian and avian pair-bonding species for which data are available (see Tsapelas, Fisher and Aron, 2010; Westneat et al., 1990).

In fact, infidelity is so widespread and persistent in monogamous avian and mammalian species, including humans, that scientists now refer to monogamous species as practicing

"*social monogamy*," in which partners display the array of social and reproductive behaviors associated with pair-bonding while not necessarily displaying sexual fidelity as well.

Myriad psychological, sociological and economic variables play a role in the frequency and experience of infidelity (Tsapelas, Fisher and Aron, 2010). Most relevant to this chapter, however, Glass and Wright (1985) report that among Americans who engage in infidelity, 56% of men and 34% of women rate their marriage as "happy" or "very happy." This suggests that infidelity has biological underpinnings. Genetic studies support this hypothesis.

Walum et al. (2008) investigated 552 couples biologically, psychologically and socially. All were either married or co-habiting for five or more years. Men carrying a specific allele in the vasopressin system scored significantly lower on the Partner Bonding Scale, indicating less feelings of attachment to their spouse. Moreover, their questionnaire scores were dose dependent: those carrying two of these alleles showed the lowest scores for feelings of attachment, followed by those carrying only one allele, followed by those carrying no copies of this allele. Men carrying this gene also experienced more marital crises during the past year, including threat of divorce. These results were also dose-dependent; men with two copies of the allele were approximately twice as likely to have had a marital crisis as those who had inherited either one copy or no copies. Men with one or two copies were also significantly more likely to be involved in a partnership without being married. Last, the spouses of men with one or two copies of this allele in the vasopressin system scored significantly lower on questionnaires measuring marital satisfaction.

This study did not measure infidelity directly; instead it measured several factors likely to contribute to infidelity. But animal studies show a similar correlation between genetic variations in the vasopressin system and partner instability. Among prairie voles,

polymorphisms in a similar gene in the vasopressin system contribute to the variability in the strength of the monogamous pair-bond (Hammock & Young 2002), including the degree to which individuals express sexual fidelity (Ophir, Wolff, & Phelps, 2008). In another recent study (of 181 young adult humans), Garcia et al (2010) found a direct link between specific alleles in the dopamine system and a greater frequency of uncommitted sexual intercourse (i.e., one night stands), as well as a higher frequency of sexual infidelity.

Another biological system may contribute to infidelity. In the now classic "sweaty tee-shirt" experiment, women sniffed the t-shirts of several anonymous men and selected the t-shirts of those they felt were the sexiest. They disproportionately selected the shirts of men with different genes (from themselves) in a specific part of the immune system, the major histocompatibility complex (MHC) (Wedekind et al., 1995). In a subsequent investigation, women married to men with similar genes (to themselves) in this part of the immune system were also more adulterous; and the more of these genes a woman shared with her spouse the more extra-dyadic partners she engaged with sexually (Garver-Apgar et al., 2006).

Brain architecture may also contribute to infidelity. I have previous proposed that humanity has evolved three broad, basic, distinct yet interrelated brain systems for mating, reproduction and parenting: the sex drive; romantic love; and feelings of deep attachment to a mating partner (Fisher 1998). These three neural systems interact with one another and many other brain systems in myriad flexible, combinatorial patterns to provide the range of cognitions, emotions, motivations and behaviors necessary to orchestrate our complex human reproductive strategy (Fisher et al 2002; Fisher 2004). Nevertheless, these three brain systems are not always well connected, making it possible for one to express feelings of attachment for one individual, *while* one feels intense romantic love

toward another, *while* one feels the sex drive for still other extra-dyadic partners (Fisher 2004). The relative biological independence of these three neural systems enable *Homo sapiens* to engage in social monogamy and clandestine infidelity simultaneously (Fisher 2004). Thus, this brain architecture easily accommodates infidelity.

Because philandering is prevalent worldwide, because it is associated with a range of psychological and sociological factors, because it is correlated with several biological underpinnings, because promiscuity is the primary reproductive strategy among our closest primate relatives, bonobos and common chimps, and because infidelity occurs even in "happy" and "very happy" marriages today, it is likely that infidelity is a core aspect of our human reproductive strategy that evolved in tandem with hominid serial social monogamy for adaptive purposes.

Many scientists have offered hypotheses regarding the selective value of infidelity (see Buss 1994). Among these, it has been proposed that in the ancestral woodland/savannah eco-niche, philandering males and females would have disproportionately reproduced, as well as reaped the reproductive benefits of genetically more varied offspring (Fisher 1992; Tsapelas, Aron and Fisher, 2010). Unfaithful females may also have garnered economic resources from extra-dyadic liaisons, as well as parenting support if their primary partner died or deserted them (Fisher 1992). Hence clandestine infidelity (in conjunction with serial and/or life long social monogamy) may have had reproductive payoffs for both ancestral males and females, selecting for the biological underpinnings of infidelity in both sexes today.

The human predisposition for philandering most likely intensifies the experience and the incidence of human love addictions, because adultery leads to partnership instability and abandonment—the crucible for rejection.

DIVORCE INTENSIFIES REJECTION ADDICTION

Negative romantic addiction to a partner may also have intensified in conjunction with the human predisposition for divorce. Human monogamy is not always life-long. Nearly half of all marriages in the US end in divorce; in fact, by age 35, 10% of American women have had three or more husbands (Cherlin 2009). Data collected between 1947 to 1989 from the Demographic Yearbooks of the United Nations on 58 societies, as well as a host of ethnographic studies, indicate that divorce and remarriage are also common cross-culturally and historically (Fisher 1992; Fisher 1989).

These data indicate three cross-cultural divorce patterns. Divorce occurs most frequently among couples with one dependent child; among couples at the height of their reproductive and parenting years (ages 25-29); and among couples married a modal duration of four years (Fisher 1989; Fisher 1992). Because four years is the common duration of birth spacing in hunting/gathering societies, and because many monogamous avian and mammalian species form pair-bonds that last *only long enough to rear the young through infancy*, this human cross-cultural modal divorce peak may represent the remains of an ancestral hominid reproductive strategy to remain pair-bonded at least long enough to raise a single child through infancy, about four years (Fisher 1992). Ancestral hominids that practiced serial social monogamy in association with offspring weaning would have created more genetic variety in their lineages, a biologically adaptive phenomenon (Fisher 1992). As a result, serial social monogamy (as opposed to lifelong monogamy) may have been common among

hominids as they expanded into the woodland/savannah eco-niche prior to 4 million years BP (Fisher 1992; Fisher 2011). This pair-bond instability may well have contributed to the evolution of the suite of traits now associated with negative romantic addictions.

BIOPSYCHOLOGICAL CONSEQUENCES OF REJECTION

It appears as if evolution has overdone the negative response to romantic abandonment. But romantically rejected individuals have wasted precious courtship time and metabolic energy; they have lost essential economic and financial resources; their social alliances have been jeopardized; their daily rituals and habits have been altered; they may have lost property; and they have most likely experienced damage to their personal happiness, self-esteem and reputation (see Leary 2001). Most important, rejected lovers of reproductive age are likely to have lost reproductive opportunities or even a parenting partner for the offspring they have already produced—forms of reduced future genetic viability. Romantic rejection has severe social, psychological, economic and genetic consequences.

Due to these profound costs, rejected individuals have inherited strong neural survival systems dedicated to helping them renew or sustain a failing partnership that is crucial to their reproductive future (Fisher 2004). The *protest* and *stress responses* and *frustration-attraction* may have evolved to motivate the lover to entice a rejecting love-object to resume the partnership. *Abandonment rage* may have evolved to escalate estrangement so the disappointed lover could begin the process of looking for a more suitable mating partner. *Anhedonia, despair* and *resignation* may have evolved to enable the rejected lover to send clear, honest signals to relatives and friends that he/she needs social support in a time of intense psychological and physical pain (Hagen 2011)

as well as time to rest and plan their next strategy to fulfill their reproductive and social goals. Indeed, mildly depressed people make clearer assessments of themselves and others (Watson and Andrews 2002).

PERSONALITY AND LOVE ADDICTIONS

During the past several years, psychologists have linked personality variations with variations in immunity to specific physical and psychological illnesses (Segerstrom et al 2010; Cohen et al 2003; Cohen et al., 2006; Cohen et al., 2012; Marsland et al., 2001; Marsland et al., 2006). I have proposed that humanity has evolved four broad, basic styles of thinking and behaving (Fisher 2009; Fisher et al., 2010b; Brown et al., in press), associated primarily with the neural systems for dopamine, serotonin, testosterone and estrogen. Perhaps individuals with particular personality dispositions are also predisposed to express particular styles of *negative* romantic love addiction. Preliminary speculations are offered here.

The constellation of cognitive and behavioral traits associated in the biological literature with dopamine and closely related norepinephrine neural pathways include: novelty-seeking, thrill and adventure seeking, impulsivity, susceptibility to boredom, abstract intellectual exploration, cognitive flexibility, openness to new experiences, curiosity, energy, verbal and non-linguistic creativity and idea generation. This trait constellation has been designated the Curious/Energetic temperament dimension and those primarily expressive of this trait constellation labeled, *The Explorer* (Fisher 2009; Fisher et al 2010b; Brown et al, in press). These men and women may be predisposed to a particular form of *negative* addiction: becoming *romance junkies* (i.e., Don Juanism). This phenomenon might entail a disproportionate inability to commit (despite one's

intense feelings of love), extreme restlessness in longer relationships, a disproportionate tendency toward infidelity, and a tendency to abandon a partner as the relationship matures in order to seek the "high" of a new romance.

The constellation of behavioral and cognitive traits associated in the biological literature with the serotonin system in the brain include: observing social norms (conventionality), adherence to plans, methods and habits, harm avoidance, orderliness, sociability, self control, conscientiousness, managerial skills (cooperation and reduced autonomous problem-solving), precision, interest in details, figural and numeric creativity and self-transcendence (religiosity). This trait constellation has been designated the Cautious/Social Norm Compliant temperament dimension, and those primarily expressive of this trait constellation have been labeled, *The Builder* (Fisher 2009; Fisher et al 2010b; Brown et al, in press). These individuals may be predisposed to a different from of *negative* romantic addiction: *attachment junkies*, thus being disproportionately controlling during a relationship, as well as predisposed to continue protesting, pursuing and pressuring a rejecting partner long after appropriate, sensible or safe.

The constellation of cognitive and behavioral traits associated with the testosterone system in the brain include: enhanced visual-spatial perception, mathematical/engineering/mechanical skills, music aptitudes, intensified focus, narrow but deep interests, less emotion recognition, less eye contact, reduced empathy, compromised verbal fluency, less social sensitivity, heightened sensitivity to social dominance, the drive for rank, emotional containment, and enhanced confidence, forthrightness and assertiveness. This suite of traits has been designated the Analytical/Tough-minded temperament dimension and those primarily expressive of this

trait constellation labeled, *The Director* (Fisher 2009: Fisher 2010b; Brown et al, in press). Individuals disproportionately expressive of this suite of traits, predominantly men (Fisher 2009; Brown et al, in press), may be predisposed to emotional flooding and concomitant abandonment rage, leading to a disproportionate incidence of domestic violence, narcissistic stalking and impulsive physical violence, including impulsive suicide and/or homicide. Some data support this hypothesis: Men are two to three times more likely to commit suicide after being rejected (Hatfield and Rapson 1996); and men are far more likely to stalk a rejecting partner, as well as batter or kill her (Meloy, Davis and Lovette 2001).

The cognitive and behavioral traits associated with the estrogen system include: contextual/holistic/synthetic thinking, linguistic and people skills, agreeableness, cooperation, theory of mind (intuition), empathy, nurturing, generosity, trust, the drive to make social attachments, heightened memory for emotional experiences and emotional expressiveness. Oxytocin, closely related to estrogen, is also associated with several pro-social traits, including trust, reading emotions in others and theory of mind (intuition). This trait constellation has been designated the Pro-social/Empathetic temperament dimension, and those who primarily express this trait constellation labeled, *The Negotiator* (Fisher 2009; Fisher et al 2010b; Brown et al in press). Individuals who primarily express this group of traits, predominantly women (Fisher 2009; Fisher et al., 2010b), may be disproportionately predisposed to obsessive, introspective (unproductive) analysis of the partnership, as well as more susceptible to clinical depression and attempted suicide in response to romantic rejection. Some data support these hypotheses. Rejected women report more severe feelings of depression (Mearns 1991), as well as more chronic strain and rumination after being rejected (Nolen-Hoeksema et al., 1999).

Women are also more likely to talk about their trauma, inadvertently re-traumatizing themselves (Hatfield and Rapson 1996).

Researchers have long proposed that different childhood experiences, specifically one's form of attachment to mother, play a significant role in one's reaction to romantic rejection. But further research may find that various love addictions, including inappropriate sexual jealousy and mate guarding, partner stalking, spouse abuse, love homicide, love suicide and clinical depression, are linked with biologically-based personality dimensions as well.

IMPLICATIONS FOR TREATMENT

Clinicians have a host of strategies for helping lovers with their issues, including their obsession for a particular relationship partner. This topic is, however, beyond the scope of this chapter. But data from anthropology and neuroscience can offer some perspective on the neural correlates of love addictions, as well as a few hypotheses regarding treatment.

Foremost, the above cross-cultural and neurochemical data show that lovers express a host of traits commonly attributed to all addictions: These include intensely focused attention (saliency), euphoria (intoxication), mood swings, intrusive/obsessive thinking, emotional and physical dependence, tolerance, distortion of reality, personality changes, the willingness to do inappropriate and dangerous things to obtain or sustain the love relationship, loss of self-control and craving for emotional and sexual union with the love-object. Moreover, these data indicate that romantic love engages a constellation of dynamic brain systems associated with craving, reward and motivation mediated by dopamine activity; and dopamine pathways are implicated in all addictions. These data clearly indicate that romantic love should be *treated* as an addiction, regardless of its official diagnostic classification (Fisher 2004).

Perhaps there is little that psychiatrists, psychologists, therapists, clergy and others in the helping professions will find necessary to do to advise individuals who are happily in love with an appropriate person, except to assure them that the anxiety, obsession, dependence, craving and other traits associated with romantic passion are natural responses. They might also recommend that the ecstatic lover refrain from making life-changing decisions until some of this natural elixir becomes subdued with time, because while in the grip of a full-blown *positive* love addiction, an individual's neural regions linked with social judgment and negative assessment become deactivated (Bartels and Zeki 2004), rendering the lover less equipped to make well-reasoned choices.

The data of anthropology and neuroscience may offer clinicians more insight, however, as they treat those with a rejection addiction. Perhaps most important, the neural data indicate that most rejected lovers should remove all reasonable evidence of their abandoning sweetheart, such as cards, letters, songs, photos and memorabilia, as well as avoid contact with their rejecting partner, because any form of reminder or contact is likely to sustain the activity of brain circuits associated with romantic passion and retard the healing process. Some rejecters feel morally blameless; others feel guilty (Baumeister, Wotman and Stillwell 1993); but most do not know how to handle the rejected lover's grief or their own feelings about the ruptured tie (Baumeister and Dhavale 2001). So although the rejecter may be friendly when the disappointed lover contacts them, most will be perplexed, annoyed or angry at the intrusion (Baumeister, Wotman and Stillwell 1993).

Clinicians might also advise disappointed lovers to join a 12-step program, preferable Sex and Love Addicts Anonymous. Many of the basic slogans would

apply to romantically rejected men and women. "*One day at a time*" suggests that the lover should refrain from contacting a departed sweetheart today. "*If you don't want to slip, don't go into slippery places*" suggests that the lover avoid people, places, music and other artifacts of the partnership that trigger romantic craving. "*It's the first drink that gets you drunk*" could be interpreted to mean: don't make that first phone call, write that first e-mail, or drive past his/her house that first time, as this is likely to lead to more efforts to connect, and more disappointment and misery. And "*Think the drink through*" could be interpreted to suggest that before the love-addict initiates any form of contact, he/she should think past the positive memories to focus on the negative events associated with their abandoning partner.

Several biological compounds have been suggested as antidotes to some of the symptoms of rejection, including oxytocin agonists, prolactin agonists and norepinephrine agonists (see Panksepp et. al. 2002). However, currently an array of serotonin-enhancing antidepressant medications are most widely used to counteract the depression associated with romantic rejection. These medications help to relieve physical and psychic pain and obsession; some may also repair some of the physical damage that has occurred, by stimulating the growth of nerve cells in the hippocampus, the brain's memory center, thereby reversing some of the harm often caused by prolonged stress (Goode, Peterson and Pollack 2002; Stahl 2000). But many of these drugs have adverse sexual side effects (See Fisher and Thomson 2007; Andrews et al., 2012); many also create apathy, or "emotional blunting" (Frohlick and Meston 2000; Rosenthal 2002). These side effects may be worth

enduring if the lover is highly dysfunctional. But as rejected lovers begin to heal, they need an active, healthy emotion system to accurately assess potential new mates, select an appropriate new partner and build a stable new relationship (Fisher, 2004; Fisher and Thomson 2007). Thus, data from neuroscience suggests that antidepressant medications, particularly Selective Serotonin Reuptake Inhibitors (SSRIs) should be used short-term, unless the individual uses these drugs long term for other medical purposes.

From the perspective of neuroscience, talking therapy is also useful to alleviate the symptoms of rejection addiction. Our research shows that rejected lovers are activating brain regions associated with assessing one's gains and losses, indicating that these men and women are trying to learn from their situation while in the scanner (Fisher et al, 2010a). *The brain is primed to engage in guided talking therapy.* Moreover, psychotherapy can produce many of the same changes in brain function that antidepressant medications produce (Brody et al., 2001; Goleman 1996; Rosenthal 2002). In fact, in some instances, "talking therapy" can be just as effective at alleviating major depression (Brody et al., 2001; Goleman 1996; Rosenthal 2002).

In one study, scientists compared 24 untreated adults suffering from the apathy, melancholy and hopelessness of major depression with 16 adults with no psychiatric problems. First, each person's brain was scanned, using fMRI. The depressed men and women showed abnormally increased activity in regions of the prefrontal cortex, caudate and thalamus; the controls showed none of these neural responses. Then 10 of the despondent subjects were administered the antidepressant, paroxetine, which elevates serotonin activity. The balance of depressed participants attended 12 psychotherapy

sessions instead. Then all of the depressed patients were scanned again. Following both forms of treatment, activity declined in those brain regions that had shown abnormal activation (Brody et al., 2001). Those who underwent the psychotherapy got a bonus, however; they registered significant new activity in regions of the insula that can inhibit feelings of depression (Brody et al., 2001). As is commonly practiced today, a combination of talking therapy and (short-term) appropriate antidepressant medication may be the most effective treatment for rejection addiction.

Data suggest that disappointed lovers should also stay busy, to distract themselves (Thayer 1996; Rosenthal 2002). This advice may be successful because any form of novelty activates the dopamine system in the brain to create energy and optimism. Physical exertion also elevates mood (Rosenthal 2002) because it triggers dopamine activity in the nucleus accumbens, bestowing pleasure (Kolata 2002). Exercise activates endorphin pathways as well, reducing pain and increasing calm. Last, strenuous physical exercise increases brain-derived neurotrophic factor (BDNF) in the hippocampus, the memory center, to protect and make new nerve cells. In fact, some psychiatrists believe that exercise (aerobic or anaerobic) can be as effective in healing depression as psychotherapy or antidepressant drugs (Rosenthal 2002)

Sunlight stimulates the pineal gland in the brain to regulate bodily rhythms in ways that elevate mood (Rosenthal 2002). Smiling utilizes facial muscles that activate nerve pathways in the brain that can stimulate feelings of pleasure (Carter 1998). Meditation affects several neural systems, thereby decreasing anxiety and escalating focus and sustained attention (Davidson et al., 1976; see Davidson and

Begley 2012). Perhaps most important, time heals. In our study of rejected men and women, the greater the number of days since rejection, the less the activity in a brain region associated with feelings of attachment (Fisher et al., 2010).

As disappointed lovers remove the stimuli that fan their ardor, follow some advisories of a 12-step program, build new daily habits, meet new people, take up new interests, find the right medication and/or therapist, and wait out the long days and nights of intrusive thinking and craving, their addiction will eventually subside. The brain is built to heal itself, most likely a trait that initially evolved so that our forebears could resume their search for an appropriate breeding and parenting partner.

CONCLUSION

Researchers have long discussed whether the compulsive pursuit of non-substance rewards, such as gambling, food and sex, can be classified as addictions (Frascella et al., 2010). Gambling, food and sex can lead to obsession, tolerance, emotional and physical dependence, withdrawals, relapse and other traits common to substance abuse. Moreover, these non-substance rewards also produce specific activity in dopamine pathways of the reward system, similar to drugs of abuse (see Frascella et al., 2010). This research suggests that uncontrolled use of these non-substances are addictions. Romantic love is likely to be a similar addiction, with one exception. Unlike all other addictions (that afflict only a percentage of the population), some form of love addiction is likely to occur to almost every human being that lives now and in our human past; few avoid the pain of rejection either.

Romantic love appears to be a *natural* addiction, "a normal altered state" experienced by almost all humans (Brown, in Frascella et al., 2010:295), that evolved during human evolution to motivate our ancestors to focus their mating energy on a specific partner, thereby conserving mating time and energy, initiating reproduction, triggering feelings of attachment and subsequent mutual parenting, and assuring the future of their DNA. It is a *positive* addiction when the relationship is reciprocated, non-toxic and appropriate; but a harmful, negative addiction when unreciprocated, toxic, inappropriate and/or formally rejected.

If the medical community comes to understand that romantic love is an evolved drive (Fisher 2004) and a natural addiction that can have profound social, economic, psychological and genetic consequences (both beneficial and adverse), clinicians and researchers might develop more effective procedures for dealing with this powerful and primordial neural mechanism. Despite it's joys, there is tyranny to love.

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Helen Fisher

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