To Have Loved and Lost:

Adolescent Romantic Relationships and Rejection

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Fisher (this volume) has written a provocative chapter about romantic love and rejection. She brings into her writing work from a number of fields to explain the origins and manifestations of romance and the consequent risks of rejection. Her major contribution in this chapter is her ability to lead us to focus our attention on the neuroscience of social emotions. In our efforts to measure and study love and romance, we often focus on subjective interpretations recorded in interviews or surveys, without consideration for underlying biological experiences. Fisher reminds us that this focus on cognitive constructions of the emotions and motivations for sex and social bonding provides an incomplete view.

Here, I take several approaches to the topic of adolescent romantic relationships and rejection. First, I examine neuroimaging studies focused on romantic love and consider the evidence for the psychophysiological properties of romantic love as a distinct drive system. Although I suggest that the data do not clearly show that romantic love is a distinct biological system, I agree with Fisher that rejection is both common and painful, and a topic of central importance in the study of adolescent romantic relations and sexuality. Relationship break-ups also may offer opportunities for personal growth. In support of these ideas, I conclude this chapter with data on sequelae of adolescent relationship break-ups.

Is the Reward System in the Brain Activated Uniquely by a Romantic Partner?

One of Fisher's important contributions in her chapter is her focus on the biological aspects of love, and in particular, on potential brain systems that are activated when we think about a romantic partner. Fisher begins with the premise that humans have three different yet interrelated brain systems for lust, romantic love, and attachment. Her chapter's basis on the assumption that romantic love is a primary drive system and is uniquely patterned in the brain led me to seek more information about the data for that assumption. In particular, how is the reward system activated uniquely by a romantic or sexual partner? Are there other dyadic relationships, such as parent-child attachments, sibling relationships, or friendships, in our lives with similar properties? Diamond has described passionate friendships (Diamond, Savin-Williams, & Dubé, 1999) characterized by intensity similar to that in romantic relationships, high levels of reciprocal intimacy, and the potential for jealousy and separation anxiety, but without a sexual component. Would such a dyadic relationship trigger brain activity similar to that linked to a romantic partner?

Neuroimaging Studies of Romantic Love

Brain-scanning studies using fMRI are offered in Fisher's chapter as one line of evidence for links between levels of dopamine and feelings of romantic love. Some readers may be unfamiliar with the neuroimaging studies cited by Fisher in her chapter, so I will briefly describe the data available on this point, examining contrasts between viewing images of the loved partner and images of friends and children. Unfortunately, data are not reported in these studies on the intensity or intimacy of the friendships that are used as comparisons for the loved partner.

Bartels and Zeki (2000) studied romantic love using fMRI to measure brain activity. They showed 17 volunteers (ages 21–37) pictures of their loved partner, and of three friends of similar age, sex, and duration of friendship as the partner (to control for familiarity, friendly feelings, and visual input), and then mapped the functional activation of specific regions of the brain. In

response to photos of the loved partner, activations were found in the medial insula and the anterior cingulate cortex, and subcortically in the caudate nucleus and the putamen. These regions did not show the same activation in response to photographs of friends.

Following up on their previous work, Bartels and Zeki (2004) conducted a similar study with 20 mothers who had a mean age of 34 (range 27–49), viewing photographs of their children who were 9 months to 6 years old (median = 20 months). The contrasts for those analyses were photographs of another child of the same age with whom they had been acquainted for about the same length of time, of their best friend, and of another acquaintance. For comparison to these mothers, Bartels and Zeki examined the romantic partner study data, separating the 11 female volunteers from the 6 males, allowing for female-only comparisons to the maternal data. The overlapping activated regions for both romantic and maternal love included the striatum (caudate nucleus, globus pallidus, and putamen), ventral tegmental area (VTA—posterior part likely active for maternal love), anterior cingulate cortex (dorsal), and middle insula (Bartels & Zeki, 2004). The activated regions common between romantic love and motherhood belong to the reward system and are known to contain a high density of receptors for oxytocin and vasopressin (Bartels & Zeki, 2004). The Fisher, Brown, and Aron collaborative fMRI study (described in Fisher, this volume) of 17 adults who had "fallen madly in love" also indicated elevated activity in the VTA and the caudate nucleus, offering support to the idea that romantic and maternal love share substantial neuroanatomical activation.

The deactivated regions of the brain were the same in the Bartels and Zeki maternal study as in the loved partner study (middle prefrontal, inferior parietal, and middle temporal cortices, amygdala, and temporal poles), although the deactivations were weaker for mothers than for romantic partners (Bartels & Zeki, 2004). In part, this might be due to the mothers' very positive feelings about the acquainted children who were the contrast picture for their own child. These

deactivated areas have been associated with critical social judgments and assessments of trustworthiness (Bartels & Zeki, 2004) and may therefore suggest that we do not cognitively process loved partners or children with suspicion. It seems that an important future direction for this work will be to consider whether trusted others to whom we are attached, such as parents, siblings, and perhaps passionate friends, elicit this same pattern of activation and deactivation.

Bartels and Zeki (2004) concluded that the similarity of the results for the mother-child dyads and the romantic partnerships was striking, and described their data as focusing on attachment-specific emotions. Not surprisingly, a few regions were specific to each form of attachment. In romantic love only, the dentate gyrus/hippocampus and hypothalamus (linked to sexual responsiveness) increased in activity. In maternal love only, the lateral orbito-frontal cortex and, subcortically, the periaqueductal gray (PAG) and the post-ventral part of the thalamus were activated. The PAG has traditionally been considered a region linked with defensive strategies, fear, and endogenous pain reduction. A review of the anatomical and functional organization of the PAG suggests that it coordinates coping strategies for dealing with escapable and unescapable environmental demands (Bandler & Shipley, 1994). How these operations are linked to maternal bonds and emotions will need to be further articulated.

Overall, in summarizing their data, Bartels and Zeki suggested that the reward structures that were activated revealed a general, modality independent network that is specialized to mediate attachment. Some of the structures activated in common across their two studies respond to food and drink reward and also to cocaine. These types of studies are provocative in that they identify active regions of the brain, but cannot yet examine the mechanisms that connect emotions and relationships to neural processing and neurotransmitters. Clearly, this type of work deserves further study.

Psychophysiological Properties of Romantic Love

It looks like there are neuroanatomical correlates to attachment—can this be extended to include a neurochemical drive system for romantic love? Fisher posits dopamine as a central feature of romantic love, but without supporting research evidence we must regard this idea with caution. It appears that her evidence for this connection is indirect—behaviors that are associated with elevated dopamine levels (energy, sleeplessness) are also linked to behaviors that may manifest in romantic love.

Even if we are convinced of a biological aspect to romantic love, does it need to be a *unique* "drive" system? Could it be that positive romantic experiences are rewarding, and we therefore respond to our beloved as we do to other family members with whom we are socially bonded, or to cocaine, good wine, or chocolate cake? It is not clear to me that there is evidence to support distinct "primary" brain systems for loving as separate from lust and attachment. Of course, in humans, cognition can intervene between neuropeptides or endorphins and sexual behavior. Perhaps the "romantic love" system is a combination of lust and attachment emotions, and the cognitive experiential features of romantic love are socially, culturally, and interpersonally constructed.

It does seem more parsimonious to consider two evolved biological systems—one for sexual arousal and lust, and one for nurturance and social bonding—while at the same time recognizing the similarities of these two systems. Both of these social feelings share neurochemical features, such as links to oxytocin and vasopressin, though in different parts of the brain and in distinct ways for males and females (Panksepp, 1998). As previously described, the neuroimaging data are consistent with a representation of these two systems as sharing many features, but with some distinct aspects.

Gender and Sexual Orientation

We need to remember that substantial gender differences in our biological systems influence sexuality. Male and female brains develop and respond differently in the areas of sex and attraction. We also have little knowledge about how these processes are similar or different for those who have same-sex attractions. I would note here that the relationships of gay and lesbian youth are invisible in Fisher's chapter. The presumption of heterosexuality is troubling, as it does not consider the neural mechanisms or neurotransmitters involved in same-sex romance. If we mapped the minds of gay men or lesbians who are madly, deeply in love, would we expect to see the same reward system active in their brains? Only through extending our research to include both same- and opposite-sex romantic attachments will we fully understand the phenomenon. The heterocentric referral to mate choice, mating drive, and mating opportunities leaves little room for consideration of the biological, or evolutionary, underpinnings of same-sex romantic love and homosexuality.

Rejection

Frustration attraction, abandonment rage, and stalking are individual reactions to rejection that are extreme and certainly not universal. It is important to know what makes someone kill their ex-partner or child because if we could predict which non-residential parents would take their children and kill them while committing suicide themselves, we could prevent tragedies. Developing this capability is not the same as understanding the impact of rejection in general.

Inappropriate responses to rejection may be socially learned, not biologically based. Previous relationship experiences and accompanying schemas for romantic involvement may predispose some rejected lovers to especially unhealthy responses. Rejection sensitivity may be one direction in which to look for such individual differences. The need for acceptance may compromise rejection-sensitive adolescents' judgment in selecting partners and their ability to

maintain relationships, and place them at risk for depression (girls) or abusiveness (boys) (Downey, Bonica, & Rincon, 1999).

Despite these individual differences, there are shared aspects to our response to rejection. Fisher argues that we are wired to suffer when we are rejected by a beloved, but it is also likely that because we are wired to be social beings, social rejection is more generally hurtful. One of my questions is, how does romantic rejection compare to the more global work on social rejection being conducted by Matthew Lieberman and his colleagues at UCLA on the shared neural system for physical and social pain? They reported last year in *Science* that fMRI scans revealed that social exclusion (simulated using a virtual ball-tossing game) was related to activation in the dorsal anterior cingulate cortex (dACC). This region is one of those identified by Bartels and Zeki (2004) as active when viewing pictures of one's romantic partner or one's child. Lieberman and Eisenberger (in press) explained that the dACC, which is connected to the experience of social pain, is also linked to the detection of conflict, and that it may therefore create attention-getting emotional states. They also have argued that the experience of social and physical pain overlaps in our neuroanatomy (Eisenberger & Lieberman, in press). Panksepp (1998) also questioned whether social reward processes exist independently of the neurochemistry of separation distress. This connection of more general social rejection to social pain and distress is consistent with Fisher's argument, but it broadens it to include relationships other than romantic partners.

In the second phase of rejection, Fisher posits that "Drugged by sorrow, most cry, lie in bed, stare into space, drink too much or hole up and watch TV" (this volume, p. XX). How is Fisher's discourse about adult rejection and its aspects of protest and despair relevant to adolescents? Are these experiences common after teen break-ups? To what extent do youth infuse their partnerships with such emotional investment? Certainly dating and breaking up are

normative aspects of adolescence (Carver, Joyner, & Udry, 2003), and we should not trivialize the importance of adolescent romance. From an adult perspective, it seems obvious that youth romance is likely to be short-lived, but the pain accompanying rejection merits our consideration. The balance of this chapter will examine adolescent experiences with relationship dissolution in a longitudinal local-area study.

Adolescent Romantic Relationship Dissolution

Study Design and Sample

The data come from the Michigan Study of Adolescent Life Transitions (MSALT), a longitudinal study that began with 6th graders drawn from ten school districts in southeastern Michigan in 1983. The majority of the sample came from White, working- or middle-class families. Longitudinal survey data from approximately 1,000 MSALT participants were used for the analyses reported in this chapter. These data were collected in 1988 in 10th grade (Wave 5) and in 1990 in 12th grade (Wave 6).

Participants were asked if they had broken up with a boyfriend or girlfriend in the previous six months (direction of rejection is unspecified, so we do not know if they were rejecting or rejected). In the 10th grade, 62% of females and 52% of males reported experiencing a relationship break-up ("Breakup5") in the previous six months. In the 12th grade, 55% of females, and 48% of males had recently broken up ("Breakup6").

Measures

Psychological adjustment was measured at Waves 5 and 6 using scales with responses ranging from 1= "never" to 7= "daily." *Depressed Mood* had three items such as "how often do you feel unhappy, sad, or depressed?" *Social Isolation* was measured with two items about how often the participant felt lonely and had trouble fitting in with others. We also collected information on drinking and bringing alcohol or drugs to school at Waves 5 and 6 for the

previous six months with the following scale: 1 = "none," 2 = "once," 3 = "2–3 times," 4 = "4–6 times," 5 = "7–10 times," 6 = "11–20 times," and 7 = "21 or more times." For complete descriptions of the psychological adjustment and substance use variables and their trajectories of change over time in this sample, see Barber, Eccles, and Stone (2001).

Results

A 2 (Gender) x 2 (Wave 5 Breakup) x 2 (Wave 6 Breakup) x 2 (time) repeated measure MANOVA was performed for each dependent variable, nesting the 2-level "time" component within subjects.

Depressed mood. As we have reported previously, a significant time effect reveals that depressed mood decreased over time, and this downward linear effect was more marked for females (Barber, Eccles, & Stone, 2001). The linear decline is also moderated by a within-subjects Breakup5 by Breakup6 by time interaction that approaches significance, $F(1, 584) = 3.55$, $p = .06$ (see Figure 1), with those who had broken up in the 10th grade, but had not in the six months preceding the 12th grade survey (represented by solid circles with solid line), experiencing the steepest decline in depressed mood across the two years. There was also a significant difference in the Breakup5 between-subjects factor, $F(1, 584) = 4.72$, $p = .03$, revealing that those who experienced a break-up in the 10th grade (represented by circles) experienced more depressed mood than those who had not (represented by squares).

Insert Figure 1 about here

I also wanted to examine a longer-term indicator of maladjustment. Those who broke up in the six months preceding the 12th grade survey were significantly more likely to say they had tried to commit suicide when we resurveyed them at age 21 (13%) than those who did not experience a break-up in the 12th grade (8%). These data do not allow

us to infer causal direction, as it is certainly plausible that relationship dissolution may be both a cause and a consequence of depressed mood and poor psychological adjustment. However, an examination of the means in Figure 1 does suggest that the groups who will break up in the 12th grade (hollow markers) are not distinguishable in the 10th grade in level of depressed mood from those who will not break up (solid markers), within each 10th-grade break-up status.

Substance use. As reported previously (Barber, Eccles, & Stone, 2001), there was a significant linear effect of time, with drinking increasing across time (M_5 = 2.5, M_6 = 3.9). Those who did not break up at Wave 5 reported drinking less frequently overall (M=2.9) than those who did break up at Wave 5 (M=3.4), $F(1, 500) = 12.08$, $p = .001$, but their rate of increase was steeper between grades 10 and 12 (M_5 = 2.0, M_6 = 3.6) than those who did break up at Wave 5 (M_5 = 2.8, M_6 = 4.1), as indicated by a significant time*Breakup5 interaction, $F(1, 500) = 4.60$, $p = .03$. Although they increase relatively more quickly across the high school years, it is important to note that they do not catch up to those who did experience a break-up in the 10th grade.

In the more serious area of bringing alcohol or drugs to school, there is a time*Breakup6 interaction, $F(1, 541) = 4.47$, $p = .04$, with those who broke up in 12th-grade experiencing an increase in bringing alcohol or drugs to school (see Figure 2). This is consistent with other prospective analyses of longitudinal data, in which Overbeek and colleagues (2003) reported an increase in young adult substance use disorders following relationship break-up. There is also an interaction of between-subjects factors Breakup5 and Breakup6, $F(1, 541) = 4.92$, $p = .03$, such that those who have a break-up in the 12th grade (represented by hollow markers) bring alcohol and drugs to school more frequently than those who did not break up in the 12th grade (represented by solid markers), but only

if they did not have a break-up in the 10th grade (see the dashed line in Figure 2 with hollow square markers).

Insert Figure 2 about here

Social isolation. Social isolation decreased across time (see Barber, Eccles, & Stone, 2001). The within-subjects interaction of time by Breakup5 by Breakup6 was significant, $F(1, 583) = 4.59$, $p = .03$, indicating that although all groups decline in isolation over time, the declines varied by the pattern of break-up experiences. A comparison of those who had not had a recent break-up in the 10th grade (represented by the square markers in Figure 3) reveals that those who subsequently had a break-up in the 12th grade (hollow squares) declined more in social isolation than those who did not (solid squares). This might be related to a connection between dating and break-ups, with some adolescents only being spared break-ups because they are missing out on socially normative dating experiences and therefore report feeling more lonely. This pattern is the reverse of the more expected pattern for those who experienced a break-up in the 10th grade (represented by the circles) with the steepest decline being among those who had broken up in the 10th grade and had not had a recent break-up in the 12th grade (represented by the solid circles).

Insert Figure 3 about here

Relationship satisfaction. The favorable position of those who had experienced a break-up in the 10th grade, but not in the 12th grade, led me to wonder about the quality of their relationships in the 12th grade. Adolescents responded to the following question: How satisfied are you with the emotional support you get from your romantic partner? Because we have this measure from 12th-grade participants only, a univariate ANOVA was conducted. Results indicated a significant main effect of Breakup5, $F(1, 545) = 4.58$, $p = .03$, with those who had broken up at Wave 5 reporting *higher* satisfaction in Wave 6

(M = 5.2) than those who had not broken up at Wave 5 (M = 4.9). There was also a significant interaction of Breakup5 and Breakup6, $F(1, 545) = 8.98$, $p = .003$, such that those who broke up in the 10th grade, but did not report a recent break-up in the 12th grade, were especially satisfied with the support they received from their romantic partners (see Figure 4). These are the same individuals who had the steepest decline in social isolation, suggesting that going through a break-up may ultimately offer some benefits to youth.

Insert Figure 4 about here

Conclusion

Romantic relationships have been suggested as an important avenue for the formation of identity in adolescence (Brown, Feiring, & Furman, 1999; Furman & Shaffer, 2003). The heightened emotions that accompany romance offer opportunities to grapple with strong feelings and learn emotion regulation skills, including managing the positive and negative emotions likely to accompany these partnerships throughout life (Diamond, 2003; Larson, Clore, & Wood, 1999). Dating relationships typically provide challenges to emotional well-being, particularly with regard to issues related to infidelity and break-ups (Welsh, Grello, & Harper., 2003). After learning which coping strategies work to help one get through a break-up, subsequent break-ups may be less difficult, or at least managed better. One may also develop insight that facilitates selecting a more compatible and supportive partner in the future. Perhaps, as Alfred Lord Tennyson said, “Tis better to have loved and lost than never to have loved at all.”

Clearly, break-ups are important to adolescents. Whether that is attributable to biology, brain activation, or social construction, or most likely a combination of all three, adolescent relationship dissolution is an important area for us to examine more closely. As Fisher points out,

some youth suffer especially dramatically, and understanding those individual differences will be important as we look ahead to develop interventions for those who lose their loves.

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