

What Does Sexual Orientation Orient? A Biobehavioral Model Distinguishing Romantic Love and Sexual Desire

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Although it is typically presumed that heterosexual individuals only fall in love with other-gender partners and gay-lesbian individuals only fall in love with same-gender partners, this is not always so. The author develops a biobehavioral model of love and desire to explain why. The model specifies that (a) the evolved processes underlying sexual desire and affectional bonding are functionally independent; (b) the processes underlying affectional bonding are not intrinsically oriented toward other-gender or same-gender partners; (c) the biobehavioral links between love and desire are bidirectional, particularly among women. These claims are supported by social-psychological, historical, and cross-cultural research on human love and sexuality as well as by evidence regarding the evolved biobehavioral mechanisms underlying mammalian mating and social bonding.

As recent debates about same-gender marriage have made clear, sexual orientation is about much more than sex. Although individuals are typically classified as lesbian, gay, or bisexual on the basis of their sexual desires, it is widely believed that sexual orientation has an affectional component as well. The sexual and affectional components are typically presumed to agree, meaning that individuals who sexually desire same-gender partners also fall in love with same-gender partners (Bell, Weinberg, & Hammersmith, 1981; Money, 1988).

However, these components do not always agree. Research conducted across different cultures and historical periods (including present-day Western culture) has found that many individuals develop passionate infatuations with same-gender partners in the absence of same-gender sexual desires (Diamond, 2000a; Faderman, 1981; Jensen, 1999; Katz, 1976; Nardi, 1992; Rotundo, 1989; W. L. Williams, 1992), whereas others experience same-gender sexual desires that never manifest themselves in romantic passion or attachment (Herdt, 1984; Whisman, 1996). For example, a recent study of sexual-identity development found that one young gay man described sex with his former girlfriend as "satisfying physically, but not emotionally," whereas another claimed that although he had been in love with his high-school girlfriend, "physically I didn't want her" (Savin-Williams, 1998, p. 110). How can this occur if sexual and affectional feelings are jointly "oriented"?

Researchers are ill equipped to answer this question because little is known about the precise association between sexual and

affectional feelings and how each is influenced by sexual orientation. Most basic research on sexual orientation treats sexual desire as the primary phenomenon to be explained, and same-gender affectional feelings receive little theoretical or empirical attention (Brown, 1995; DeCecco, 1990). This might be attributable to the common assumption that sexual desire is a more basic, biologically mediated phenomenon than is romantic love and therefore more amenable to scientific study.

Yet this assumption is outmoded. Research has demonstrated that the distinct behaviors and intense feelings associated with affectional bonds are governed not only by culture and socialization but also by evolved, neurochemically mediated processes that are a fundamental legacy of humans' mammalian heritage (Fisher, 1998; Hazan & Shaver, 1987; Nelson & Panksepp, 1998; Panksepp, 1998; Uvnäs-Moberg, 1997b). Just as sexual desire is a species-typical phenomenon with both social and biological underpinnings, so too is emotional affection. Thus, it is no longer tenable to investigate the fundamental bases of same-gender sexual desire without also considering the bases of same-gender affectional bonding and whether the two phenomena are related.

I therefore develop a biobehavioral model of love and desire that makes the following three claims. First, the evolved processes underlying sexual desire and affectional bonding are functionally independent. As a result, one can "fall in love" without experiencing sexual desire. Second, the processes underlying affectional bonding are not intrinsically oriented toward other-gender or same-gender partners. As a result, individuals can fall in love with partners of either gender, regardless of sexual orientation. Third, the biobehavioral links between love and desire are bidirectional. As a result, individuals can develop novel sexual desires—even desires that contradict their sexual orientations—as a result of falling in love.

These claims are supported by social-psychological, historical, and cross-cultural research on human love and sexuality as well as by evidence regarding the evolved biobehavioral mechanisms underlying mammalian mating and social bonding. With regard to the last source of evidence, it bears noting that the current understanding of the neurobiological substrates of social bonding is based

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predominantly on animal models (Panksepp, 1998), and the extent to which these models generalize to humans remains unknown. Although Nelson and Panksepp (1998) have noted that there is considerable cross-species generality in the neural circuits underlying mammalian affiliation, Carter (1998) has noted that there is considerable cross-species variation in the affective and behavioral manifestations of these circuits. Thus, generalizations from animals to humans must be considered speculative pending future research.

A final caveat is necessary: In calling attention to the biological substrates of love and desire, I do not mean to imply that biological factors are more important than cultural factors in shaping these experiences. On the contrary, research across many disciplines has shown that human experiences of sexual arousal and romantic love are always mediated by social, cultural, and interpersonal contexts, and ignoring these contexts produces a distorted account of human experience (Tolman & Diamond, 2001). However, ignoring the biological underpinnings of human behavior produces a similarly distorted account. As others have argued (Andersen, Cyranowski, & Aarestad, 2000), human sexual and affectional experiences are neither "mainly cultural" nor "mainly biological" but must always be understood as products of powerful interactions between biological and social factors. This model's focus on biobehavioral mechanisms should not be mistaken for a dismissal of cultural influences.

A Biobehavioral Model of Love and Desire

First, clarification of relevant terms is in order. Following Regan and Berscheid (1995), *sexual desire* is defined as "a wish, need, or drive to seek out sexual objects or to engage in sexual activities" (p. 346). The terms *romantic love*, *affectional feelings*, and *affectional bonding* denote the feelings of infatuation and emotional attachment that are commonly associated with romantic relationships (distinctions between infatuation and attachment are clarified below). Finally, the term *gender* is used to refer to the categories male and female to avoid confusion with *sex* as a reference to sexual activity.

The model begins with the following assumption: Most individuals possess a relatively stable tendency to seek sexual partners of the same gender, the other gender, or both genders—this tendency is denoted *sexual orientation*.¹ Although extensive debate remains over whether sexual orientation really exists, whether it is a fixed trait, and whether it is biologically based, these debates are not engaged here. Rather, I assume that sexual orientation does exist, that it is relatively stable (see Diamond, 2000b; Pattatucci & Hamer, 1995), and that in some individuals it has some biological component (evidence on this point is reviewed below). However, sexual orientation is not presumed to be the sole factor determining sexual attraction and behavior. Researchers have long noted that human sexual responses are flexible and amenable to conditioning (Bancroft, 1989; Cass, 1990; Money, 1988), and thus individuals sometimes experience sexual desires that run counter to their overall orientation (e.g., see Baumeister, 2000). With these assumptions in place, the present model concerns itself with the following question: Does sexual orientation fundamentally circumscribe the class of individuals with whom one can fall in love? I posit that the answer is no, and the reasons are spelled out below.

Premise 1: Sexual Desire and Romantic Love Are Functionally Independent

Although sexual desire and romantic love are often experienced in concert, they are governed by different social-behavioral systems that evolved to serve different goals. As argued by Fisher (1998), desire is governed by the *sexual mating* system, the goal of which is sexual union for the purpose of reproduction. Romantic love, however, is governed by the *attachment or pair-bonding* system (Hazan & Shaver, 1987; Hazan & Zeifman, 1999), the goal of which is the maintenance of an enduring association between two individuals. Evolutionary theorists have argued that in the environment in which humans evolved, highly dependent offspring were far more likely to survive if they had the care of both parents in the early years of life (Mellen, 1982), and the social-behavioral system of pair-bonding accomplishes this aim by establishing a robust emotional bond that keeps mates together past the initial mating episode.

Obviously, not all human mating involves pair-bond formation. Rather, the basic processes underlying mating and pair-bonding are functionally independent. It has been argued that this is a relatively recent mammalian adaptation (most pronounced in humans) that facilitated ecologically contingent flexibility in reproductive strategies (Fisher, 1998). This functional independence allows humans not only to mate without bonding but also to bond without mating. Furthermore, humans can bond without experiencing the motivation to mate (i.e., sexual desire), under the right conditions. These conditions appear to be high levels of proximity and physical contact over sustained periods of time (Hazan & Zeifman, 1994). Because sexual desire provides a powerful incentive for such behaviors, it facilitates pair-bonding, but it is not a precondition. Rather, high degrees of time, togetherness, and touch can "stand in" for sexual desire in facilitating the development of romantic love.

This premise has the following three implications. First, individuals should be capable of experiencing romantic love in the absence of sexual desire. Second, individuals should be capable of experiencing romantic love for individuals to whom they are not typically sexually oriented. In other words, heterosexuals should be capable of falling in love with same-gender partners, and lesbian or gay individuals should be capable of falling in love with other-gender partners. Third, these phenomena should be most likely to occur in relationships containing unusually high proximity or physical contact over sustained periods of time.

Premise 2: Romantic Love Is Not Intrinsically Oriented to Same-Gender or Other-Gender Partners

Whereas Premise 1 maintains that sexual orientation does not necessarily circumscribe one's experiences of romantic love, Premise 2 specifies that love does not have an orientation of its own. This premise is based on the hypothesized evolutionary

¹ Because *sexual orientation* is used to denote an individual's general tendency to seek sexual-romantic partners of the same gender, the other gender, or both genders, it would be more technically accurate to call this *sexual-romantic orientation* or *partner orientation*. However, I continue to use *sexual orientation* because of its widespread use and familiarity among both scientists and laypeople.

origins of love and desire. As noted earlier, the evolutionary goal of sexual desire is sexual reproduction, and therefore one can make a plausible—albeit still controversial—argument that sexual desires evolved to be intrinsically oriented toward other-gender partners (as they are in the vast majority of cases, recently documented by Laumann, Gagnon, Michael, & Michaels, 1994) in order to selectively target individuals' mating efforts toward appropriate reproductive partners. According to this view, homosexual and bisexual orientations represent (at least in some cases) intrinsic deviations from this normative program.

Is there a similarly plausible evolutionary justification for intrinsic affectional orientations? As noted above, pair-bonding enhances reproductive success by keeping mates together long enough to successfully rear their offspring past the initial, most dangerous stage of life. Accordingly, we might expect the emotions of pair-bonding—like sexual desires—to be intrinsically oriented toward those who are the “right” gender to be reproductive partners. Yet numerous psychologists, anthropologists, ethologists, and evolutionary biologists have argued that although the powerful emotions associated with pair-bonding are reproductively advantageous, they did not originally evolve in the context of reproductive mating. Long before the evolutionary “problem” of keeping reproductive mates together arose, mammals had already been endowed with a potent social-behavioral system for social bonding: *infant-caregiver attachment*, a system that originally evolved to keep highly dependent mammalian infants in close proximity to their caregivers (Bowlby, 1958, 1973a, 1973b, 1980, 1982). As Gould and Vrba (1982) argued, natural selection does not generally result in the production of brand-new mechanisms to solve evolutionary problems where existing ones will suffice. Thus, it has been argued that the infant-caregiver attachment system was exploited for the new purpose of maintaining enduring associations between adult reproductive partners (Hazan & Shaver, 1987; Panksepp, 1998). In other words, adult pair-bonding appears to be an *exaptation*—a system that originally evolved for one reason but comes to serve another (Gould & Vrba, 1982).

The notion that romantic love is an adult “version” of the powerful affectional bond between infants and their caregivers was first systematically proposed and debated nearly 15 years ago (Hazan & Shaver, 1987, 1994; Hazan & Zeifman, 1999; Shaver, Hazan, & Bradshaw, 1988), and since that time it has arguably become the predominant theoretical perspective underlying research on adult romantic relationships. Yet the implications of this perspective for conceptualizations of same-gender romantic love have gone largely unnoticed: Specifically, if the mechanisms underlying romantic love originally evolved to facilitate infant-caregiver attachment (a hypothesis supported by the direct correspondences, reviewed in depth below, between the feelings, behaviors, and neurobiological substrates of infant-caregiver bonding and adult romantic love), then intrinsic affectional orientations—if they exist—must have evolved in the context of infant-caregiver attachment rather than adult mating. Yet such orientations are implausible in the infant-caregiver context. Although infant-caregiver attachment may not be wholly gender neutral (given that most caregivers are female), infants do not become selectively attached to other-gender versus same-gender caregivers, and it would be maladaptive if they did. Thus, there is no plausible evolutionary basis for other-gender or same-gender ori-

entations to be coded into the biobehavioral processes underlying affectional bonding.

This implies that although individuals might report stable tendencies to fall in love with one gender or the other, such tendencies have no intrinsic basis. Rather, they might reflect the fact that adults typically only encounter the situational conditions that facilitate affectional bonding (sustained, heightened proximity and physical contact) with individuals who are actual or potential sexual partners. Yet once these situational conditions are in place, individuals should be capable of falling in love with partners of either gender.

Premise 3: The Links Between Love and Desire Are Bidirectional

Although love and desire are functionally independent, most individuals perceive and experience powerful interconnections between these experiences. Many developmental psychologists have suggested that these interconnections become established during adolescence (Furman & Wehner, 1994; Hazan & Zeifman, 1994; Laursen, 1996; Sullivan, 1953) such that reproductively mature individuals end up being most likely and most motivated to bond with potential reproductive partners. Processes of classical conditioning may help establish these links, given that adolescents' increasingly frequent and intimate other-gender interactions (Buhrmester, 1996; Laursen, 1996) provide them with repeated opportunities to experience affectional feelings in concert with newly urgent sexual desires. Cultural norms also play a role, sending strong messages regarding what types of feelings and behaviors are appropriate with different social partners. Finally, these interconnections appear to have a neurobiological component: Animal research has found that oxytocin, a neuropeptide hormone that is critically implicated in mammalian affectional bonding, also facilitates mammalian sexual interest and behavior. Thus, overlap in some of the biobehavioral mechanisms underlying sexual desire and affectional bonding might contribute to the perceived links between these experiences.

Although the overall psychobiological process through which love and desire become interconnected during normal sociosexual development has never been fully specified, there is tacit consensus regarding the outcome of this process: a robust pathway leading from sexual desire to infatuation-attachment, but not the other way around. Although we are expected to form affectional bonds with individuals we sexually desire, we are not expected to develop novel sexual desires as a result of affectional bonding. It is important to note that this notion of unidirectionality in the links between love and desire has never been theoretically justified or empirically tested. Premise 3 maintains that these links are not unidirectional. Rather, the cultural practices, psychological associations, and shared biobehavioral mechanisms that link love and desire are more likely to foster bidirectional than unidirectional pathways between these experiences, such that sexual desire can facilitate affectional bonding, and affectional bonding can facilitate sexual desire.

This premise implies that individuals should be capable of developing sexual desires as a result of falling in love, even desires that run counter to their sexual orientation. Because such “cross-orientation” desires emanate from the process of affectional bonding, they should be relationship specific and may not generalize to

other partners. Premise 3 also implies that women should be more likely than men to develop such affectionally based sexual desires. This is because the cultural, psychological, and neurobiological links between love and desire appear to be more robust among women than among men. Women have been historically socialized to restrict their sexual feelings and behaviors to intimate emotional relationships—ideally marital ties—whereas males have not (Gagnon & Simon, 1973), and women appear more likely than men to have their first experiences of sexual arousal in interpersonal rather than solitary contexts (Hyde & Jaffee, 2000). Women might also have more extensive neurobiological interconnections between the experiences of romantic love and sexual desire: Animal research has demonstrated that oxytocin's effects on both attachment and sexual behavior are estrogen dependent and gender specific. If bidirectionality between love and desire is based on just such cultural, psychological, and neurobiological processes as Premise 3 postulates, then it follows that women should be more likely to report cross-orientation affectionally based sexual desires than men.

Evidence for the Theory

Premise 1: Does Love Require Desire?

In considering whether sexual desire is a precondition for romantic love, one must first decide what type of romantic love should be investigated. Numerous researchers accord with a basic distinction between *infatuation* (also known as *passionate love*, *falling in love*, or *limerence*) and *attachment* (also known as *companionate love*; Hatfield, 1987; Sternberg, 1986; Zeifman & Hazan, 1997). In a self-report study of over 1,000 individuals, Tennov (1979) found that infatuation was characterized by intense desires for proximity and physical contact, resistance to separation, feelings of excitement and euphoria when receiving attention and affection from the partner, fascination with the partner's behavior and appearance, extreme sensitivity to his or her moods and signs of interest, and intrusive thoughts of the partner. The same features were noted by Hatfield and Sprecher (1986) as characteristics of passionate love. In contrast, attachment or companionate love is characterized by feelings of calm, security, mutual comfort seeking, and deep affection (Hatfield, 1987; Hazan & Shaver, 1987; Sternberg, 1986).

This basic distinction has been validated in numerous studies assessing adults' self-reported experiences in romantic and sexual relationships (e.g., Hazan & Shaver, 1987; Hazan & Zeifman, 1994; Money, 1980; Sprecher & Regan, 1998). Research suggests that infatuation and attachment are not simply different types of love but rather different stages of love: Specifically, infatuation represents an early-developing component of the bonding process. For example, Sprecher and Regan (1998) collected relationship descriptions from over 200 couples at various stages of relationship development. They found that the longer couples had been together, the fewer "passionate" and the more "companionate" characteristics their relationship contained. The same phenomenon was documented in a questionnaire study of over 100 couples by Breznsnyak, Allen, Salz, Mattucci, and Hazan (1996). For example, longer term couples reported less frequent hugging, cuddling, sexual contact, mutual gazing into one another's eyes, and intense desires for physical proximity but were more likely to report

mutual provision of emotional security and comfort. Zeifman and Hazan (1997) provided a plausible rationale for this sequence of emotional experiences. They noted that the establishment of a pair-bond requires extended proximity between partners over a sustained amount of time, and the intense preoccupation of infatuation provides a potent motivator for such sustained proximity.

Of course, not all infatuations "make it" to the attachment stage, and not all attachments are preceded by infatuation. The main point is that if both passionate infatuation and companionate attachment are parts of the social-behavioral system of pair-bonding, and if the process of pair-bonding is functionally independent from sexual desire, then sexual desire should not be a precondition for either experience. Notably, this runs directly counter to conventional wisdom on this topic. Sexual desire has been found to be a more frequent and more prominent component of the infatuation stage of love than the attachment stage (Aron & Aron, 1991; Berscheid, 1985; Regan, 1998; Sprecher & Regan, 1998; Tennov, 1979), and therefore, many researchers have argued that it is impossible to authentically experience infatuation without desire (Lee, 1973; Money, 1997). Premise 1 maintains that this is not the case.

Evidence for romantic love without desire. Extant empirical data support this prediction. For example, Tennov's (1979) exhaustive study of infatuation found that 61% of women and 35% of men reported experiencing infatuation without feeling "any need for sex" (p. 74). Even stronger evidence was provided by a study by Hatfield, Schmitz, Cornelius, and Rapson (1988). They hypothesized that if sexual desire were a necessary component of infatuation, then the weakest experiences of infatuation should be observed among prepubertal children, and the strongest experiences should be observed among postpubertal adolescents, given that the latter have undergone maturational surges in gonadal hormones that produce notable increases in day-to-day sexual desire (Udry & Billy, 1987; Udry, Talbert, & Morris, 1986). To test this hypothesis, Hatfield et al. administered the Juvenile Love Scale (based on the well-validated Passionate Love Scale; Hatfield & Sprecher, 1986) to over 200 youths between 4 and 18 years of age to measure the intensity of their infatuation experiences. Respondents were asked to think about an other-gender boyfriend or girlfriend for whom they had intense feelings (respondents were not given the opportunity to nominate a same-gender friend) and to rate their agreement with statements such as "I am always thinking about X" or "When X hugs me my body feels warm all over." The intensity of respondents' infatuation experiences were then correlated with their degree of pubertal maturation (measured with standardized assessments of physical development).

The results were unequivocal: Children of all ages were capable of maximally intense infatuations, and the intensity of these experiences was not associated with pubertal maturation. Although the authors appropriately cautioned that their results could not reveal whether the subjective experience of infatuation was fundamentally the same for 4-year-olds as for 18-year-olds, these data nonetheless provide evidence that sexual arousal is not the "spark" that intensifies the preoccupation, separation distress, and heightened proximity seeking of infatuation.

Evidence for same-gender infatuations among heterosexuals. There is also evidence that, as Premise 1 predicts, individuals can become infatuated with partners of either gender, regardless of sexual orientation. Documentation of same-gender infatuations

among heterosexuals provides more reliable evidence on this point than documentation of other-gender infatuations among lesbian, gay, or bisexual individuals, because cultural pressures might lead lesbian, gay, or bisexual individuals to misreport or misperceive experiences of other-gender affection (Savin-Williams, 1998). Thus, the discussion below focuses on same-gender infatuations among self-described heterosexuals.

There is extensive evidence of such infatuations. Anthropologists and historians have described unusually intimate, passionate, platonic same-gender friendships among otherwise heterosexual individuals in a variety of different cultures and historical periods, dating as far back as ancient Greece (Blackwood, 1985; Brain, 1976; Faderman, 1981; Gay, 1985; Hansen, 1992; Katz, 1976; Richards, 1987; Rotundo, 1989; Smith-Rosenberg, 1975; W. L. Williams, 1992). These bonds often inspired their own unique terms, such as *romantic friendships* (Faderman, 1981; Rotundo, 1989), *bond friendships* (Firth, 1967), *mummy-baby friendships* (Gay, 1985), *camaradia* (Reina, 1966), or *smashes* (Sahli, 1979). One 19th-century schoolmistress described smashes as

... an extraordinary habit which [schoolgirls] have of falling violently in love with each other, and suffering all the pangs of unrequited attachment, desperate jealousy etc. etc., with as much energy as if one of them were a man. . . . If the "smash" is mutual, they monopolize each other & "spoon" continually, & sleep together & lie awake all night talking instead of going to sleep. (Sahli, 1979, p. 22)

W. L. Williams (1992) documented similarly intense but non-sexual bonds between Native American men, and noted that early Western explorers were surprised by how these men seemed to fall in love with one another (Parkman, 1969; Trumbull, 1894). Brain (1976) documented passionate friendships between young Bangwa men in the Cameroon and reviewed reports of comparable male-male ties in Melanesia (Malinowski, 1929), Samoa (Mead, 1943), the Polynesian islands (Firth, 1967), and Guatemala (Reina, 1966). According to these accounts, such relationships involved "affection of an extreme kind which . . . resembles more the passion of heterosexual lovers than the calm friendship of equals" (Brain, 1976, pp. 39-40).

Modern observers reading such descriptions often assume that these relationships contained a subverted sexual element and that if the participants had lived in a more permissive environment, they would have pursued an openly sexual liaison. However, those who study and document such relationships have argued against this view, noting that the presumption of a necessary link between same-gender affectional bonds and same-gender sexual desires is historically and culturally specific (see especially D'Emilio & Freedman, 1988; Faderman, 1981, 1993; Nardi, 1992). Although some of these relationships might have involved sexual interest, these authors maintained that this was not uniformly so.

Contemporary Western culture lacks a defined category for platonic same-gender infatuations, yet they continue to occur and have been most frequently documented between women (Diamond, 2000a; Rothblum, 1993; Von Sydow, 1995). Olicker (1989) noted that many contemporary women describe the beginning of a same-gender best friendship with regard to "excitement, heightened energies, frequent thought about the other, invigorated self-regard—in short, in terms of the ardent sensibilities of romantic love" (p. 5). Similarly, Rubin (1985) directly likened new best friendships among some women to "new loves" (p. 113), noting

that the two women often become obsessively intertwined. Von Sydow's (1995) interview study of older German women found that a number of respondents (none of whom were sexually attracted to women) described passionate adolescent same-gender friendships that involved kissing, cuddling, dancing together, or sleeping in the same bed. One woman remarked, "My first love was a girl. . . . It was wonderful!" (p. 288) despite indicating that she found the notion of same-gender sexual relationships disgusting.

Contemporary passionate friendships may be more common among women than among men because of differences in normative standards for male-male and female-female friendships. Both W. L. Williams (1992) and Nardi (1992) noted that the contemporary West adheres to a particularly rigid notion of heterosexual masculinity that precludes openly affectionate male-male bonds. Thus, highly intimate and affectionate same-gender friendships are more likely to engender suspicion of homosexuality when they occur between men than when they occur between women (Derlega, Lewis, Harrison, Winstead, & Constanza, 1989). This was not the case in 19th-century America (Hansen, 1992) or in the non-Western cultures reviewed by Brain (1976), where passionate friendships between men were more common.

Evidence for the importance of time, togetherness, and touch. Obviously not all individuals form such bonds. If sexual desire is not responsible for transforming a close friendship into an infatuation, then what is? Premise 1 implies that because sustained physical proximity plays a critical role in the process of pair-bonding, same-gender infatuations among heterosexuals should be most likely to develop when relationships contain heightened levels of proximity or physical contact over sustained periods of time.

This is consistent with the available cross-cultural data. Descriptions of passionate same-gender friendships frequently make reference to the extensive time that friends spend together, often in close physical contact. For example, passionate friends are often described as living with or near one another, sharing beds, being "inseparable," and engaging in frequent physical affection (Gay, 1985; Hansen, 1992; Katz, 1976; Richards, 1987; Rotundo, 1989; Sahli, 1979; Smith-Rosenberg, 1975). The importance of time, togetherness, and touch might also explain why same-gender affectional bonds appear disproportionately likely to develop in gender-segregated environments. Both Smith-Rosenberg (1975) and Richards (1987) pointed out that men and women in 19th-century America occupied distinctly separate occupational and social spheres and suggested that this gender segregation facilitated same-gender bonding. Similar arguments were made by Sahli (1979) and Gay (1985) with regard to the gender-segregated environments that gave rise to smashes and mummy-baby friendships. Pleck and Pleck (1980) and D'Emilio and Freedman (1988) further argued that the intense male-male bonding that has historically characterized the battlefield, the American frontier, and numerous fraternal organizations is partially attributable to the fact that these environments were "male-only" spaces.

A similar phenomenon can be identified in contemporary gender-segregated colleges, boarding schools, sororities, athletic teams, and fraternities (Golden, 1987; Von Sydow, 1995). Gender-segregated environments obviously heighten individuals' opportunities for time, togetherness, and touch with one another, and thus it is not surprising that they appear to facilitate the development of

same-gender infatuations and attachments. They also restrict individuals' contact with other-gender individuals, whose sexual desirability (at least to heterosexuals) might draw attention and energy away from same-gender friends. Supporting this conceptualization, one of Von Sydow's (1995) respondents noted that the same-gender crushes she and her girlfriends routinely developed "stopped when we started noticing the boys" (p. 288).

Such reports imply that the difference between same-gender friendships and same-gender infatuations is one of degree rather than kind, a notion that runs counter to the widespread belief that falling in love involves an altogether different process than the formation of a close friendship. Aron, Dutton, Aron, and Iverson (1989) directly tested this proposition in a series of studies involving over 500 male and female undergraduates in which self-reported elicitors of *falling in love* (i.e., developing a strong attraction to someone) were compared with self-reported elicitors of *falling in friendship* (i.e., going from not knowing much about someone to developing very strong positive feelings for him or her). A content analysis of the responses revealed that the most common triggers for falling in love were exactly the same as those for falling in friendship: reciprocal liking, propinquity, desirable characteristics, and similarity.

These findings imply that the boundary between same-gender friendship and infatuation might be relatively permeable. Of course, it is certainly sensitive to conscious and unconscious perceptions regarding the feelings and behaviors that are considered appropriate for each type of relationship. Modern Western society is replete with implicit and explicit messages dictating that heightened proximity seeking and frequent physical affection only occur (and are only acceptable) with potential sexual-romantic partners (Rothblum, 1997; W. L. Williams, 1992). These messages undoubtedly constrain the type and degree of intimacy that individuals pursue with same-gender friends (O'Connor, 1992). In cultures without such pervasive messages and in which same-gender friends typically spend a great deal of time in close proximity to one another, same-gender infatuations might be far more likely to develop.

Areas requiring further study. More conclusive evidence for the claim that sexual desire is not a prerequisite for infatuation would be provided by research on the actual psychobiological process of human affectional bonding, which has been the subject of little systematic study (Diamond, 2001). For example, comprehensive, multimethod comparisons between new and established couples and friendship dyads would allow researchers to ascertain the affective and behavioral causes and consequences of pair-bonding, chart their respective time courses, and identify their potential underlying mechanisms. Longitudinal investigations could discern whether extended proximity, physical affection, and sexual contact facilitate (as research would appear to suggest) or are facilitated by human attachment formation. Both are probably true (Brennan, Wu, & Loev, 1998), but the question of whether time, togetherness, and touch are truly necessary or sufficient conditions for pair-bonding is an important and empirically answerable question. Future research should also investigate conditions other than gender segregation, such as psychological stress, that facilitate same-gender bonding. The physiological arousal associated with stress is well known to influence romantic attraction in humans (reviewed in Foster, Witcher, Campbell, & Green,

1998) and social bonding in animals (Carter, 1998; Carter & DeVries, 1999). This is clearly a key area for future research.

Premise 2: Is Love Intrinsically Oriented?

Even if sexual desire is not a precondition for romantic love, one might still posit that sexual orientation circumscribes romantic love because it is coded into the pair-bonding process separately. In other words, individuals might be intrinsically predisposed to pair-bond with one gender or the other (or both). Premise 2 challenges this notion, maintaining that there is no plausible evolutionary explanation for gender-based affectional orientations. This is because the biobehavioral mechanisms underlying affectional bonding originally evolved in the context of infant-caregiver attachment, a context in which such orientations would have been maladaptive.² Clearly, the cornerstone of this argument is the notion that the processes underlying adult pair-bonding originally evolved to facilitate infant-caregiver attachment, and this notion cannot be tested directly. We can, however, critically evaluate the degree of correspondence between the feelings, behaviors, and neurobiological substrates of infant-caregiver attachment and adult pair-bonding. Although the existence of close correspondences cannot prove, in and of itself, that romantic love evolved in the context of infant-caregiver attachment, the absence of such correspondences would directly contradict this claim.

Before reviewing the empirical data on this point, evidence for the existence of intrinsic sexual orientations warrants a brief review. Although this issue is theoretically and empirically distinct from the issue of affectional orientations, it merits discussion because it highlights the extent to which a plausible theoretical and empirical case can be made for intrinsically oriented sexual desires but not for intrinsically oriented affectional feelings.

Evidence regarding the orientation of sexual desire. Heterosexually oriented sexual desires would clearly have been evolutionarily adaptive, because they would have propelled individuals to mate with other-gender partners, thereby facilitating successful reproduction (Bailey, Dunne, & Martin, 2000). As noted earlier, this would not require that individuals only experience desires consistent with their sexual orientation. As long as individuals

² Of course, the question of whether the caregiving system is gender specific—that is, whether women are more biologically predisposed to experience the powerful feelings of care and nurturance toward infants than men—is obviously controversial. At the present time, there is no direct evidence that this is the case among humans. However, as reviewed by Panksepp (1998), animal research has revealed gender differences in the oxytocinergic and opioid circuits that influence the onset and maintenance of caregiving behavior in new parents. Many of these behaviors have been shown to depend on interactions between these neural circuits and the female gonadal hormones of estrogen, progesterone, and prolactin, all of which undergo dramatic changes during pregnancy and parturition. However, the implications of the extant animal data for human behavior are as yet unknown. Also, human caregiving is obviously subject to far more conscious control and cultural shaping than is the case for other mammals. Consequently, even if the neural circuits influencing caregiving are, in fact, gender differentiated, this need not suggest that human females are necessarily predisposed to be more willing or effective caregivers than human males. Similarly, it is not known whether such gender differences might have implications for gender differences in the propensity to form adult romantic pair-bonds.

were generally oriented to seek sexual contact with other-gender partners, a degree of flexibility in sexual arousal would incur no evolutionary costs. This is supported by data on nonhuman primates indicating that periodic same-gender sexual activity never completely supplants other-gender sexual activity and thus does not hinder reproductive success (Nadler, 1990; Wallen & Parsons, 1997).

If heterosexual orientations did, in fact, evolve to facilitate sexual mating, then they should be coded in our genes; correspondingly, nonheterosexual orientations should also have a genetic basis. Numerous studies have found support for this hypothesis. For example, self-identified lesbian, gay, and bisexual individuals are more likely to have lesbian, gay, and bisexual relatives than would be predicted by chance (Bailey & Bell, 1993; Bailey & Benishay, 1993; Bailey, Pillard, Neale, & Agyei, 1993; Pattatucci & Hamer, 1995). Also, studies of unseparated twins have detected significant concordance of self-reported sexual orientation in identical twins (usually around 50%) and greater concordance among identical than fraternal twins (Bailey et al., 1993; Bailey & Pillard, 1991). The best and most reliable study to date examined nearly 2,000 pairs of twins drawn from the Australian Twin Registry (Bailey et al., 2000) and found concordances of 38% for same-gender sexual desire in identical male twins, 30% for identical female twins, and no concordance in fraternal twins. Notably, these concordance estimates are lower than those found in previous twin studies, which might stem from the fact that the Australian study recruited participants from a twin registry rather than lesbian, gay, and bisexual publications (as in previous studies) making it less subject to self-selection biases.

In summary, the genetic studies converge to suggest that the orientation of some individuals' sexual desires has some genetic component, although there is no direct confirmation of this view. Furthermore, it is not yet known what genes orienting sexual desire might code for. Do they determine specific patterns of perinatal hormonalization (L. Ellis, 1996), atypical features of brain anatomy (LeVay, 1993), or temperamental traits leading to gender-typed social behaviors (Bem, 1996)? The end result might be heterosexual, homosexual, or bisexual desires, but it is not clear whether this result is functional or artifactual. In the final analysis, the specific causal pathway is not germane to the model presented here. The main point is that there is both a plausible evolutionary basis for sexual desires to be oriented toward the other gender and empirical evidence that same-gender desires are partly genetically determined. Thus, it is reasonable and parsimonious to view sexual desires as intrinsically oriented, with heterosexual orientations overwhelmingly predominant and homosexual-bisexual orientations representing infrequent variations. The same cannot be said with regard to pair-bonding. Unlike sexual desire, the emotions underlying pair-bonding did not originally evolve to facilitate mating, but infant-caregiver bonding. The evidence in support of this claim is reviewed below, after a brief overview of the infant-caregiver attachment system.

The evolution of infant-caregiver attachment. Attachment theory (Bowlby, 1958, 1973a, 1973b, 1980, 1982) maintains that because mammalian (and particularly primate) offspring require substantial care and feeding after birth, the psychological mechanism of attachment evolved to facilitate the formation of enduring, survival-promoting bonds between mothers and their highly dependent offspring.³ This mechanism ensures that infants maintain

close proximity to their caregivers at all costs during the first few years of life, thereby dramatically increasing their chances for survival. The attachment system is driven by emotions. When infants are too far from their caregivers, they experience distress and signal the caregiver for attention. Once the caregiver is sufficiently close, the infant feels calmed and can resume developmentally appropriate behaviors such as exploration.

Although attachment is a species-typical, somewhat automatic process, it is not instantaneous; rather, it takes 6–12 months of regular contact for an infant to develop a basic, functional attachment⁴ to his or her caregiver, a period of time that has been described as "attachment-in-the-making" (Ainsworth, Blehar, Waters, & Wall, 1978, p. 24). During this period, the infant displays an increasingly intense fixation on the adult with whom he or she has the most extensive contact. By the end of this period, the infant's relationship with the caregiver is notably distinct from his or her other social relationships. Although there is no single marker that an attachment bond is in place, their core characteristics involve heightened seeking of proximity and contact with the attachment figure (accompanied by distinct physiological responses to such contact) and intense resistance to separation from the attachment figure (again, accompanied by distinct physiological responses to such separations). These characteristics have been observed not only in humans (Ainsworth, 1967; Ainsworth et al., 1978; Bowlby, 1973b, 1982; Field, 1985, 1994) but across a variety of mammalian species, such as rats (Hofer, 1987, 1994), guinea pigs (Graves & Hennessy, 2000), and nonhuman primates (Berman, Rasmussen, & Suomi, 1994; Hoffman, Mendoza, Hennessy, & Mason, 1995; Suomi, 1999).

Evidence for emotional-behavioral correspondences between pair-bonding and infant-caregiver attachment. There is increasing (albeit not universal) consensus and voluminous evidence from human and animal research that adult pair-bonds and infant-

³ There is considerable diversity in the strength and long-term functioning of infant-caregiver attachments across different mammalian species. The only other species showing infant-caregiver attachments as strong and enduring as human attachments are Old World monkey and ape species (Suomi, 1999).

⁴ It is important to note that there are stable individual differences in the security of attachments formed between infants and caregivers (Ainsworth, 1967; Ainsworth et al., 1978; Weinfield, Sroufe, Egeland, & Carlson, 1999) and between adult romantic partners (Brennan & Shaver, 1995; Crowell, Fraley, & Shaver, 1999; Hazan & Shaver, 1987; Simpson, 1990), and these individual differences typically receive more theoretical and empirical attention than normative processes of human attachment formation (Diamond, 2001; Marvin & Britner, 1999; Simpson & Rholes, 1998), which are of greater interest here. Because this model focuses on the basic establishment of an attachment bond and not the quality of that bond, individual differences in attachment security are not discussed. As elucidated by Hinde (1982) and Weiss (1982), the process of becoming attached (which requires a certain amount of time in proximity to the potential attachment figure) and the status of a relationship as an attachment bond (which can be inferred from certain affective and behavioral characteristics of the relationship) are independent of individual differences in the quality of that bond (i.e., whether proximity to the attachment figure succeeds in making the individual feel secure). As Bowlby (1956) demonstrated, children reliably form robust, enduring attachments to abusive caregivers. The quality of those bonds is undoubtedly low, but the bond still qualifies as an attachment.

caregiver attachment involve the same basic emotions and behaviors. Among mammals that form reproductive pair-bonds (and not all mammals do—see Insel, Young, & Wang, 1997), the behaviors that characterize pair-bonding are the same as those that characterize infant-caregiver attachment: selective proximity seeking, visual tracking, grooming, huddling, and separation distress (Carter, 1998; Carter, DeVries, & Getz, 1995; Mason & Mendoza, 1998). The same behavioral correspondences have been observed between infant-caregiver attachment and adult pair-bonding in humans (first systematically detailed by Hazan & Shaver, 1987). For example, initial attachment formation between infants and caregivers (attachment-in-the-making) is characterized by heightened attempts by the infant to gain proximity to the attachment figure, marked distress during physical separations, increased smiling, visual-motor orientation, and positive greeting responses selectively directed to the attachment figure (Ainsworth, 1967; Bowlby, 1982). As discussed earlier, analogous characteristics are observed during adult infatuation: intense desires for proximity to and physical contact with the partner, resistance to separation, intrusive thoughts of the partner, and fascination with the partner's behavior and appearance (Hatfield, 1987; Tennov, 1979; Zeifman & Hazan, 1997). Furthermore, the cues that have been shown to trigger infatuation—propinquity and reciprocal liking—correspond directly to the cues that target infants' attachment behavior toward the "right" caregiver: familiarity and responsiveness (Hazan & Diamond, 2000).

Correspondences extend to the later phases of bonding, as well. As the infant matures, short-term separations no longer provoke extreme distress, but extended separations continue to be associated with marked behavioral and affective disruptions reminiscent of depression (Ainsworth et al., 1978; Bowlby, 1982, 1988). The same dynamics have been found to characterize adult romantic relationships, evidenced by self-report data on proximity seeking, contact seeking, and separation distress in long-term relationships (Brezsnyak et al., 1996; Hazan & Zeifman, 1994); observational studies of couples' interactions before, during, and after stressful experiences (Fraley & Shaver, 1998; Simpson, Rholes, & Nelligan, 1992); and couples' behavioral and affective responses to brief and long-term separations from one another (reviewed in Vormbrock, 1993).

Evidence for neurobiological correspondences between adult pair-bonding and infant-caregiver attachment. Stronger evidence for the shared evolutionary origin of adult pair-bonding and infant-caregiver attachment is provided by research on the neurobiological substrates for these processes. It is important to note that all of the extant data on this issue come from animal research, and extrapolations to humans must obviously be conducted with caution. Yet thus far, extant findings strongly support the notion that infant-caregiver attachment bonds and adult pair-bonds are mediated by the same neurobiological circuits. Initial research in this area focused primarily on the role of endogenous opioids in general affiliative behavior, but in recent years there has been increasing attention to the neuropeptides oxytocin and vasopressin in selective social bonding (such as infant-caregiver attachment and pair-bonding). Both oxytocin and vasopressin are involved in selective social bonding, yet because oxytocin appears to play a uniquely important role for infant-caregiver attachment and adult pair-bonding, I focus my review on oxytocin.⁵

Oxytocin is a neuropeptide hormone produced in the hypothalamus that is released into circulation from the posterior pituitary; oxytocin is also released directly into the brain from neurons in the paraventricular nucleus. Brain oxytocin receptors are found throughout the limbic system and in the brain stem, particularly in areas associated with emotion, autonomic control, and reproductive and social behavior. Oxytocin is most well known for stimulating the contractions of labor and facilitating milk letdown in nursing mothers, but it is also involved in multiple processes of mammalian attachment and affiliation over the life course. Studies of animals (typically rats and prairie voles) have identified direct effects of oxytocin on maternal feeding behavior, maternal-infant bonding, and kin recognition (Carter, 1998; Nelson & Panksepp, 1996; Pedersen, Caldwell, Walker, & Ayers, 1994; Uvnäs-Moberg, 1994). Like endogenous opioids, oxytocin has powerful conditioning effects that are implicated in the formation of stable preferences for places, stimuli, and other animals. For example, one study demonstrated that rats that had been conditioned to prefer one experimental compartment to another were induced to reverse this preference by pairing exposure to the nonpreferred compartment with central injections of oxytocin (Liberzon, Trujillo, Akil, & Young, 1997). Another study found that when interactions with novel social partners were accompanied by oxytocin infusion, rats showed enhanced social memory for these interaction partners (Popik, Vetulani, & van Ree, 1992).

Such findings have been interpreted to suggest that oxytocin-mediated conditioning effects may be an important mechanism—along with opioid-mediated conditioning effects—through which mammals form stable, intrinsically rewarding bonds to specific social partners, most importantly the mother. Rats, for example, normally show a strong preference for odors associated with their mothers (Galef & Kaner, 1980), which is one of the indicators of attachment, and administration of an oxytocin antagonist prevents rats from developing this normative preference (Nelson & Panksepp, 1996). Oxytocin also facilitates the mother's attachment to her infant. Central injections of oxytocin can induce adult ewes to form strong social attachments to unfamiliar lambs (Keverne & Kendrick, 1992), and administration of oxytocin antagonists to rats extinguishes certain maternal behaviors such as pup retrieval (Pedersen et al., 1994).

Proximity and physical contact may be important for initiating these bonding processes. Oxytocin release in rats is facilitated by multiple forms of social stimulation, including touch, warmth, light pressure, and massage (Uvnäs-Moberg, Bruzelius, Alster, & Lundberg, 1993; Witt, Winslow, & Insel, 1992), and may be responsible for the comforting effects typically associated with such contact. Uvnäs-Moberg et al. (1993) found that in addition to facilitating oxytocin release, physical vibration, warmth, and mild electro-acupuncture were all capable of attenuating rats' behavioral reactivity to experimental stress. Moreover, after administering central injections of an oxytocin antagonist, physical stimula-

⁵ Vasopressin is a related neuropeptide that differs from oxytocin in only two of nine amino acids, is synthesized in the same mammalian brain regions as oxytocin, and has both analogous and antagonistic effects on attachment and affiliative behaviors (Carter & DeVries, 1999). There has been more extensive research on oxytocin than vasopressin, and thus in the interests of space I focus only on oxytocin.

tion no longer produced these stress-attenuating effects. A later study (Uvnäs-Moberg, 1997a) established that chronic central infusions of oxytocin in rats over a 5-day period produced sedation, reductions in blood pressure, reductions in stress reactivity, and reductions in stress hormone levels, and these effects persisted for several weeks after oxytocin treatments were terminated. Furthermore, a study of rat pups separated from their mothers and littermates found that central injections of oxytocin significantly reduced these pups' distress vocalizations (Insel & Winslow, 1991). On the basis of such findings, researchers such as Uvnäs-Moberg (1998) have postulated that the physiologically and psychologically soothing and rewarding effects of infant-caregiver attachment would initially be conferred through direct physical contact and mediated by the release of oxytocin and endogenous opioids. Yet through conditioning processes, mental representations of attachment figures—the affectional bond itself, as it were—may become a signal for the release of these neurochemicals and thereby confer the same physiological and psychological effects originally elicited by direct physical contact (Knox & Uvnäs-Moberg, 1998; Uvnäs-Moberg, 1998).

If the biobehavioral processes underlying romantic love originally evolved in the context of infant-caregiver attachment, as Premise 2 suggests, then the oxytocinergic mechanisms reviewed above should also underlie adult pair-bonding. There is extensive evidence from animal studies that this is the case. Much of this research has focused on prairie voles, which are one of the few species of rodents to form enduring pair-bonds. Pair-bonding in voles is typically studied by placing two "stranger" voles in an experimental chamber under controlled conditions and later testing whether the voles prefer one another's company to that of other voles. As with infants' preferences for their mothers, oxytocin appears to mediate these partner preferences. Female prairie voles who were exposed to novel males just after receiving a central oxytocin infusion subsequently displayed a preference for these partners over other males (Cho, DeVries, Williams, & Carter, 1999), but when exposure to a novel male was paired with administration of an oxytocin antagonist, voles failed to form such a preference (Insel & Hulihan, 1995; J. R. Williams, Insel, Harbaugh, & Carter, 1994).

Also, as with the infant-caregiver context, physical contact plays an important role in these effects, and its influence appears to be mediated by oxytocin release. Prairie voles establish stable preferences for partners more quickly if they have mated with the partner (J. R. Williams, Catania, & Carter, 1992) or if they have had extended nonsexual cohabitation and frequent physical contact with the partner, and central injections of oxytocin facilitate this process (J. R. Williams et al., 1994). Notably, the female voles in this particular study had been ovariectomized, demonstrating that gonadal hormones are not prerequisites for pair-bonding. Mason and Mendoza (1998) therefore argued that it is the oxytocin release provided by physical contact—and not necessarily sexual contact—that facilitates pair-bonding between reproductive partners.

It is on the basis of such findings that researchers working in this area (Carter, 1998; Carter & Keverne, 2002; Panksepp, 1998; Panksepp, Nelson, & Bekkedal, 1997) generally maintain that adult pair-bonding and infant-caregiver attachment share the same neurobiological substrate, a conclusion that supports the notion of a shared evolutionary origin for these two processes. This shared evolutionary origin is the basis for Premise 2's primary assertion,

that individuals do not possess intrinsic affectional orientations for one gender or the other.

Evidence regarding the lack of affectional orientations. It is practically impossible to find reliable evidence for or against this assertion, given that most research on sexual orientation (and, most importantly, all of the genetic research on sexual orientation) either collapses assessments of sexual and romantic tendencies into a single construct (e.g., Pattatucci & Hamer, 1995) or only assesses the former (e.g., Bailey et al., 2000). The few studies that have reported independent assessments of each dimension show that individuals often experience disjunctures between the degree to which they are sexually versus emotionally drawn to the same gender (Diamond, in press-b; Weinberg, Williams, & Pryor, 1994).

It is not clear how to interpret such findings. On the one hand, self-reported gaps between affectional and sexual "tendencies" might be interpreted as evidence that independent affectional orientations do exist and that they are independent of an individual's sexual orientation. On the other hand, they might reflect the fact that when describing their patterns of affectional feelings, individuals take into account their previous experiences and conscious preferences regarding close relationships. For example, many heterosexual as well as lesbian or bisexual women have explicitly acknowledged that although they are equally capable of emotionally bonding with women and men, they prefer to develop affectional bonds with women because women are more emotionally responsive (Diamond, in press-b). Notably, many gay and bisexual men report the same preference for emotional relationships with women (Diamond & Dubé, 2002; Nardi, 1999; Savin-Williams, 1998). Consequently, differences between individuals' self-reported sexual and affectional tendencies cannot be interpreted as reliable evidence for or against the existence of intrinsic affectional orientations.

Given these ambiguities, it is instructive to revisit the animal data. If mammalian pair-bonding is intrinsically heterosexually oriented in the majority of cases (as appears to be true for their sexual desires), then same-gender, nonsexual pair-bonds should be exceedingly rare among mammalian species, and it should not be possible to "induce" such pair-bonds on the basis of situational factors. There are only a small number of studies that speak directly to this question, but they converge to indicate that nonsexual, same-gender pair-bonds are indeed observed in (heterosexual) mammals, although such bonds do not appear to be as exclusive or enduring as heterosexual reproductive pair-bonds. Same-gender pair-bonds are most likely to occur in mammalian species exhibiting communal or cooperative breeding, in which the care of offspring is not managed exclusively by a male-female reproductive pair but is shared with a network of extended family members. Notable examples include "female-bonded" primate species (Wallen & Tannenbaum, 1997; Wrangham, 1980), in which bonds between female kin and affiliates are of preeminent importance in fostering infant care and promoting reproductive success (reviewed in Carter & Keverne, 2002; Taylor et al., 2000). Female-female bonds in such systems serve many attachment-like functions, such as security and protection (Wallen & Tannenbaum, 1997), and they are typically manifested and maintained by the same behaviors that characterize male-female pair-bonds: high degrees of proximity seeking, physical contact, and mutual grooming (Baldwin, 1985; Dunbar, 1996). Evidence that such bonds are analogous to infant-caregiver attachments and adult reproductive

pair-bonds is provided by research on squirrel monkeys demonstrating that females separated from their bonded female affiliates show the same forms of physiological stress reactivity (specifically, activation of the hypothalamic-pituitary-adrenocortical axis) as have been classically observed when infants are separated from caregivers and adults are separated from their pair-bonded mates (Hennessy, 1997; Hennessy, Mendoza, & Kaplan, 1982).

Unfortunately, the biobehavioral mechanisms underlying female-female bonds in such species (as well as mammals in general) have remained largely unexplored (Carter & Keverne, 2002). Although researchers have argued that such mechanisms are fundamentally derived from the same oxytocin and opioid circuits governing infant-caregiver attachment and adult reproductive pair-bonding (Keverne, Nevison, & Martel, 1999), very few studies speak directly to this question. The most important data on this topic come from a study on same-gender pair-bonding in prairie voles (DeVries, Johnson, & Carter, 1997). Using the classic partner-preference paradigm, this study showed that 24 hr of cohabitation with a same-gender partner produced reliable social preferences for that partner in both male and female voles. However, later introduction of a novel other-gender vole disrupted these same-gender pair-bonds, suggesting that the motives and rewards of mating may "trump" those of nonreproductive pair-bonds in reproductively mature animals. This notably brings to mind the aforementioned observation by one of Von Sydow's (1995) respondents that she and her friends stopped developing same-gender infatuations once they started "noticing the boys." Interestingly, a subsequent study (DeVries & Carter, 1999) detected gender differences in voles' propensity to form same-gender pair-bonds. Specifically, female voles formed such preferences more quickly after cohabitation than males, and the females' same-gender preferences were more robust over time. The authors hypothesized that this may reflect the differential adaptive significance of affiliative bonding for male versus female reproductive success, as noted above regarding female-bonded social systems.

These findings support the prediction that the biobehavioral mechanisms underlying mammalian pair-bonding are not intrinsically oriented according to the same-gender-other-gender status of one's partner. Such orientations would not only be maladaptive for infant-caregiver attachment, but they would be maladaptive for communal or cooperative breeding systems, in which the neural substrates for pair-bonding appear to be involved—at least to some extent—in the formation of same-gender bonds. Rather, a more plausible conceptualization of mammalian attachment was provided by Mason and Mendoza (1998), who argued that primate attachment relies on *dynamic action schemata*. In other words, primates are born with a complex, diffusely distributed, relatively stable neurobiological structure equipping them to form filial attachments. Yet although the selection of the attachment figure is guided by certain species-characteristic dispositions, the attachment schema is inherently "open" and opportunistic, ready to assimilate what the environment affords. Although Mason and Mendoza were speaking of the infant-caregiver context, this model works just as well when considering same-gender pair-bonds.

Areas requiring future study. Most of the evidence reviewed above comes from animal studies, and thus a chief priority for future research is to determine whether the neural circuits underlying mammalian attachment have the same types of influences on

human affect and behavior as have been identified in animals. For example, what types of human social interactions facilitate oxytocin release, and is there a direct relationship between the affective quality of an interaction and the amount of oxytocin released during the interaction? It is important that such research not be limited to oxytocin. As others have noted (Taylor et al., 2000), a number of neurochemicals other than oxytocin, brain opioids, and gonadal hormones—such as serotonin, dopamine, prolactin, vasopressin, and norepinephrine—also influence mammalian social behavior, although they have not received as much sustained investigation (see Bagdy & Arato, 1998; Insel & Winslow, 1998; Panksepp, 1998; Panksepp et al., 1997; Schwarzborg, Kovács, Szabó, & Telegdy, 1981). Future research must investigate the independent and interacting influences of these neurochemicals.

Another question for future investigation is the extent to which most individuals perceive their affectional feelings to be oriented in the same manner as their sexual feelings. As noted above, most research on sexual orientation does not assess self-perceived tendencies to bond affectionally with one gender or the other. Collecting such assessments is important for determining whether, for example, affectional feelings are more or less situationally variable than sexual feelings and whether stable affectional tendencies develop at different ages than sexual tendencies. Disjunctures between sexual and affectional feelings also deserve attention. Extant data suggest that such disjunctures often play a critical role in shaping individuals' judgments regarding their "true" sexual identities (Diamond, in press-b), underscoring the importance of integrating assessments of affectional feelings into research on same-gender sexuality.

Premise 3: Can Love Lead to Desire?

Whereas Premises 1 and 2 emphasize distinctions between love and desire, Premise 3 emphasizes the connections between these experiences that are established and maintained by cultural practices (such as norms specifying that long-term pair-bonds are only formed with sexual partners), psychological processes (such as learned associations between love and desire), and shared neurobiological substrates (such as oxytocin and endogenous opioids). Oxytocinergic links between love and desire are of particular interest. In addition to mediating attachment-related feelings and behaviors, oxytocin also mediates sexual behavior. Animal research has found that exogenous administration of moderate amounts of oxytocin stimulates females to seek out sexual activity (Argiolas, Melis, Mauri, & Gessa, 1987; Floody, Cooper, & Albers, 1998) and to show receptivity to sexual requests (Arletti & Bertolini, 1985; Caldwell, Prange, & Pedersen, 1986; Gorzalka & Lester, 1987). In fact, the highest circulating levels of oxytocin in humans are detected during sex, and oxytocin has been implicated in the experience of orgasm and the feeling of satiety that follows sexual activity (Carmichael, Warburton, Dixon, & Davidson, 1994; Carter, 1992, 1998; Riley, 1988). Thus, oxytocin might be critically implicated in the robust interconnections between love and desire that become established and subsequently reinforced in the years between puberty and adulthood.

It is important to note that conventional wisdom posits these links to be unidirectional: That is, although one can fall in love with an object of sexual desire, one is not expected to develop novel sexual desires as a result of falling in love. Premise 3,

however, maintains that the cultural, psychological, and biobehavioral pathways linking love and desire are bidirectional, such that individuals can develop sexual desires as a result of affectional bonding, even if such desires contradict their sexual orientation. Given that these cross-orientation desires are dependent on the emotional processes associated with pair-bonding, they should be specific to the relationship in question.

Evidence for relationship-specific, cross-orientation desires. There is evidence in support of this prediction. Scientific and popular writings on sexual orientation are replete with accounts of individuals whose same-gender desires revolve around specific people they unexpectedly fell in love with rather than same-gender partners in general (Cassingham & O'Neil, 1993; Golden, 1996; Pillard, 1990; Savin-Williams, 1998; Whisman, 1996). Notably, such reports are often greeted with skepticism. As Blumstein and Schwartz (1993) noted, the conventional understanding of sexual orientation maintains that it is impossible to have "only some" same-gender attractions for "only some" special people, and that individuals making such claims are consciously or unconsciously misrepresenting their feelings in order to avoid the stigma of homosexuality (p. 177). With enough time, such individuals are expected to recant tales of relationship-specific desires and claim lesbian, gay, or bisexual identities.

Certainly, some do. In the process of telling their "coming-out" stories, many lesbian, gay, and bisexual individuals report that although they initially thought their same-gender attractions were restricted to one special person, they eventually realized this was not so (e.g., Jensen, 1999; Stanley & Wolfe, 1980). Yet of course, these accounts come from the most self-selected sample possible: openly identified lesbian, gay, and bisexual individuals. A stronger test of whether nonsexual affectional bonds can give rise to temporary, relationship-specific sexual desires would be provided by evidence that not only can heterosexual individuals develop such desires in the context of same-gender affectional bonds but that lesbian and gay individuals can also develop such desires in the context of other-gender affectional bonds.

A recent longitudinal study of female sexual identity development provides evidence for both of these phenomena. In this study, approximately 80 nonheterosexual women were interviewed shortly after coming out and then two additional times during the next 5 years (Diamond, 1998, 2000b, in press-a, in press-b). Consistent with prior research (Cassingham & O'Neil, 1993; Golden, 1987; Jensen, 1999), several of these women reported at the initial interview that their first (and sometimes only) experiences of same-gender desire were restricted to specific female friends with whom they had developed unusually intense emotional bonds. If all of these women were misrepresenting their true feelings, one would expect them to eventually recant these explanations once they became more comfortable with their lesbian or bisexual identities.

This was not what happened. By the 5-year follow-up interview, 7 women had gone back to identifying themselves as heterosexual, and 3 of these women were among the group that had originally experienced their same-gender desires only in the context of specific relationships (Diamond, 2000c, in press-a). These women reported that once their special relationship ended, so did their same-gender desires, and all expressed a degree of surprise and sadness at the change. Even more interesting, 4 of the openly identified lesbians in this sample reported having unexpectedly

fallen in love and become sexually involved with close male friends in the 5 years since their first interview. As with relationship-specific same-gender desires, these other-gender desires caught women by surprise, and several expressed outright embarrassment about them. All of these women explicitly stated that they remained predominantly sexually attracted to women, and that the men with whom they fell in love constituted exceptions.

Of course, these cross-orientation, relationship-specific desires were reported by only a small number of women, and the findings require replication with more diverse samples. However, these data suggest that although most individuals begin a romantic relationship with feelings of sexual desire and end up experiencing infatuation and attachment, this process can operate in the opposite direction. Consequently, not all experiences of same-gender desire or same-gender passionate attachment should be taken as definitive indicators of intrinsic same-gender sexual orientations. Rather, bidirectional links between the psychological and biobehavioral processes underlying love and desire may render a range of same-gender and other-gender sexual and romantic feelings possible at different stages of life and under different circumstances.

Importantly, all of the evidence outlined above for bidirectionality is culled from research on women, raising the question of whether love and desire are more bidirectional among women than men. The present model suggests that this may be the case, given that there appear to be more robust cultural, psychological, and neurobiological links between love and desire among women than men. For example, many societies actively constrain women's sexual activity to affectional contexts (Gagnon & Simon, 1973) or deem that female sexual activity is only acceptable when it occurs with a steady rather than a casual partner (reviewed in Hyde & Durik, 2000). Men, in contrast, are typically granted considerably more latitude in their sexual behavior. Furthermore, female socialization practices often focus on fostering communal orientations in women, which might reinforce women's perceptions that their sexual desires are interpersonally based (Andersen et al., 2000). Perhaps most intriguingly, animal research has demonstrated that oxytocin's effects on attachment and sexual behavior are estrogen dependent and therefore highly gender specific (Caldwell, Walker, Pedersen, Barakat, & Mason, 1994; Carter, 1992; McCarthy, Kow, & Pfaff, 1992), suggesting potential gender differences in the neurobiological connections between love and desire. For example, research on rats has detected more extensive oxytocin circuits in female than male brains, perhaps to facilitate oxytocin-dependent caregiving behaviors (Panksepp, 1998), and some oxytocin receptors have been found to be sexually dimorphic (De Wied, Diamant, & Fodor, 1993). If bidirectionality is based on just such cultural, psychological, and neurobiological connections between love and desire, then it follows that it should be more pronounced among women than among men.

Evidence for gender differences in bidirectionality. It has long been a truism that sex and love are more fused for women than for men (Nichols, 1987), and apparently both men and women believe this to be the case. Regan and Berscheid (1995) asked male and female undergraduates what they thought caused male versus female sexual desire, and found that the most widely endorsed causes of male sexual desire were biological processes and a physical "need" for sex. In contrast, the most widely endorsed causes of female sexual desire were interpersonal experiences

related to romantic love. Research on lesbian and bisexual women further supports a link between love and desire: Lesbian and bisexual women frequently report feeling emotional same-gender attractions before physical same-gender attractions, and physical attractions often first develop in the context of an existing emotional bond (Blumstein & Schwartz, 1993; Gramick, 1984; Rose & Zand, 2000; Rose, Zand, & Cimi, 1993; Vetere, 1982; Whisman, 1996).

Women are also more likely than men to say that they become attracted to—or fall in love with—the person and not the gender (Blumstein & Schwartz, 1993; Golden, 1987; Savin-Williams, 1998) and appear more likely than men to engage in (and enjoy) sexual behavior that runs counter to their established pattern of sexual desire, that is, heterosexual women engaging in sexual behavior with women (Davis, 1929/1972; Dixon, 1984, 1985; Goode & Haber, 1977; Pillard, 1990) and lesbian women engaging in sexual behavior with men (Bart, 1993; Chapman & Brannock, 1987; Clausen, 1999; Diamond, 2000b, in press-a, in press-b; Rust, 1992, 2000; Sophie, 1986; Weinberg et al., 1994). It is important to note that intense emotional bonds are one of the most common catalysts for such experiences. In such cases, women typically report that their unusually strong emotional feelings spill over into sexual desire (Bart, 1993; Cassingham & O'Neil, 1993; Clausen, 1999; Davis, 1929/1972; Diamond, 2000b, in press; Peplau & Cochran, 1990; Peplau & Garnets, 2000; Pillard, 1990; Whisman, 1996).

Recently, Baumeister (2000) discussed such phenomena as examples of greater sexual plasticity among women than men. Yet he portrayed the influence of affectional relationships on plasticity as functionally equivalent to the influence of other situational and social factors, such as education and societal permissiveness. The common denominator linking such influences, in his analysis, was their externality, because he emphasized that women's sexual responses, relative to men's, are motivated more by external context than by internal factors (p. 348). In a subsequent article on gender differences in sex drive, Baumeister and colleagues (Baumeister, Catanese, & Vohs, 2001) elaborated on the importance of extrinsic motivation for female sexuality, arguing that "male desire aims at the sexual activity itself, whereas female desire aims beyond it toward other outcomes and consequences" (p. 263). They listed women's need for a "relationship context" for sex as a prime example of this phenomenon. This interpretation may be apt, but it is incomplete: In addition to providing an influential external context for sexual desire and activity, affectional bonds might also shape the internal experience of desire by activating the shared neurobiological substrates linking these two subjective experiences.

Potential biobehavioral mechanisms underlying gender differences in bidirectionality. In considering this possibility, the distinction between proceptive and receptive sexual desire (Beach, 1976; Wallen, 1995) proves instructive. *Proceptivity* denotes the urge to seek out and initiate sexual activity, whereas *receptivity* denotes the capacity to become interested in sex on encountering certain stimuli and is sometimes called *arousability* (Bancroft, 1989). This distinction is well known to those who study the sexual behavior of nonhuman primates (Hrdy, 1987) but has received far less attention in discussions of human sexuality, with a few notable exceptions (Bancroft, 1989; Baumeister, 2000; Fisher, 1998; Wallen, 1995). Research (as reviewed by Wallen, 1995) has found

that proceptive desire is directly mediated by gonadal hormones: androgens in men and both androgens and estrogen in women. Thus, the fact that women's levels of circulating androgens are substantially lower than those of men, coupled with the fact that they only experience high estrogen levels a few days per month, might partially explain (in concert with cultural factors) why women generally experience fewer spontaneous sexual urges on a day-to-day basis than men (Beck, Bozman, & Qualtrough, 1991; Byers & Heinlein, 1989; Julien, Bouchard, Gagnon, & Pomerleau, 1992; Knoth, Boyd, & Singer, 1988; Laumann et al., 1994; O'Sullivan & Byers, 1992) and fewer sexual fantasies (B. J. Ellis & Symons, 1990; Leitenberg & Henning, 1995).

Yet notably, researchers have detected no direct relationship between gonadal hormones and arousability (Abramson, Repczynski, & Merrill, 1976; Griffith & Walker, 1975; Hoon, Bruce, & Kinchloe, 1982; Slob, Ernste, & van der Werff ten Bosch, 1991). In fact, even hypogonadal men with castrate levels of testosterone become readily aroused to erotic stimuli (Bancroft, Tennent, Loucas, & Cass, 1974; Kwan, Greenleaf, Mann, Crapo, & Davidson, 1983). It is important to note that if the proceptive component of women's sexual desire is more quiescent than men's because of their different hormonal status, then a greater proportion of the desires they do experience might be attributable to arousability, and this might be the context in which pathways from love to desire operate. Animal research suggests a possible role for oxytocin in this regard. As noted above, studies of rats have found that oxytocin administration facilitates both proceptive sexual interest (Argiolas et al., 1987; Floody et al., 1998) and greater sexual receptivity (Arletti & Bertolini, 1985; Caldwell et al., 1986; Gorzalka & Lester, 1987; Witt & Insel, 1991). However, oxytocin's effects on receptivity appear to be estrogen dependent (Arletti & Bertolini, 1985; Caldwell et al., 1986; Gorzalka & Lester, 1987). Perhaps, then, romantic love facilitates arousability via oxytocin release, and perhaps this effect is disproportionately likely among women because of its estrogen dependence. This does not, however, discount the influence of culture and socialization on sexual feelings experienced within affectional contexts but rather suggests that cultural influences might be facilitated by gender-differentiated biobehavioral processes.

Areas requiring future study. The hypothesis that oxytocin plays a role in mediating gender-differentiated bidirectional pathways between love and desire is admittedly speculative at the current time, given how little is known about the role of oxytocin in mediating both affectional and sexual feelings in humans. Furthermore, although it might seem plausible to posit straightforward, dose-dependent associations between oxytocin levels and emotional responses (such that low levels facilitate feelings of comfort whereas high levels facilitate sexual desire), research on animals suggests that it is not quite this simple. In rats, prolonged exposure to high levels of oxytocin appears to induce feelings of sexual satiety rather than arousal, and in male rats such exposure promotes nonsexual rather than sexual physical contact (Witt et al., 1992). Research on humans has shown that although high levels of oxytocin are released during sexual activity, high levels are also released during lactation, and most breast-feeding women report declines rather than increases in sexual interest (Adler & Bancroft, 1983; Kayner & Zagar, 1983). Clearly, the context in which oxytocin is released—both interpersonally and neurohormonally—may be critically implicated in oxytocin's subjective conse-

quences, and these issues must be carefully considered in future research. We also do not know the extent to which oxytocin functioning in humans is gender differentiated and whether this is attributable to interactions between oxytocin and human gonadal hormones. This question might be answered by studies investigating whether oxytocin functioning changes over the course of adolescence as a function of pubertal changes in gonadal hormones. One possibility is that maturationally dependent interactions between oxytocin and gonadal hormones play a role in linking perceptions and experiences of affectional and sexual feelings during the adolescent years.

A promising paradigm for testing such possibilities involves assessing *oxytocin reactivity*, or the degree to which exposure to certain stimuli elicits increases in oxytocin release (manifested in increased blood-plasma levels of oxytocin). Prior research on individual differences in oxytocin reactivity (Light et al., 2000; Turner, Altemus, Enos, Cooper, & McGuinness, 1999) suggests fascinating directions for future study. For example, Turner et al. (1999) measured women's plasma levels of oxytocin after three different episodes: pleasant massage, positive emotional imagery, and negative emotional imagery. Some women showed consistently greater oxytocin reactivity to the massage and positive emotion inductions than others, and these women were also less likely to report intrusive behavior in their close relationships (i.e., inappropriate self-disclosure, high attention seeking, and difficulty spending time alone). One possible (albeit speculative) interpretation of this finding is that women with low oxytocin reactivity experience disproportionately fewer affective rewards from their social relationships as a result of their oxytocin response patterns and that their intrusive behavior is a form of compensation. One might then consider whether high oxytocin reactivity is associated with a heightened capacity to form strong affectional bonds or whether individual differences (and, of course, gender differences) in oxytocin reactivity are related to the bidirectional links between love and desire. Research pairing assessments of the quality of individuals' prior and current intimate relationships with experimental measures of oxytocin reactivity would provide a fascinating new perspective on these questions.

The influence of situational factors such as environmental stress on oxytocin release also requires further study. Oxytocin is released during mild to moderate stress and helps to reduce the stress-related activity of the hypothalamic-pituitary-adrenocortical axis (Chiodera et al., 1991; Uvnäs-Moberg, 1997b). Considering both its conditioning and stress-reducing effects, oxytocin release might account for the robust observation that attachment formation is greatly facilitated by mild to moderate stress in both primates (Mason & Mendoza, 1998) and humans (Simpson & Rholes, 1994). Notably, the stress-reducing and mildly sedative properties of oxytocin are stronger in females than males (Jezova, Jurankova, Mosnarova, Kriska, & Skultetyova, 1996), suggesting that stress-induced oxytocin release may play a more important role for platonic attachment formation among women than among men. This is consistent with Taylor et al.'s (2000) argument that affiliation may constitute a fundamental component of mammalian females' biobehavioral responses to stress and that females therefore form such bonds more readily than males. Considering that stress is also known to influence subjective experiences of attraction (Foster et al., 1998), the potential role of psychological stress

in facilitating gender-differentiated bidirectional pathways between love and desire is a promising area for future consideration.

Implications for Gender Differences in Sexuality and Sexual Orientation

Clearly, the present model has numerous implications for conceptualizing and explaining gender differences in sexuality, not all of which have been addressed in depth above. For example, in addition to the phenomenon of bidirectionality and the importance of relational contexts for female sexual desire, this model has implications for considering gender differences in sexual development. Research has reliably demonstrated that interpersonal relationships exert a greater influence on female adolescents' first experiences of sexual desire and behavior than on males' (e.g., Hyde & Jaffee, 2000; Udry & Billy, 1987). Previous explanations of such gender differences have (appropriately) emphasized the strong cultural messages instructing young women to confine their sexuality to relational contexts. However, as noted earlier, the present model implies that it should not be presumed that relational contexts only function as external contexts. Rather, the emotions associated with affectional bonding might reconstitute "internal" experiences of sexual desire, potentially shaping girls' subjective experiences (and not just behavioral expressions) of sexual-developmental transitions. This also has implications for interpreting gender differences in sexual dysfunction, particularly gender differences in the problem of low (or nonexistent) sexual desire (Beck, 1995; Leiblum & Rosen, 2000). Sex therapists have long acknowledged that this disorder involves a complex interplay of cultural, interpersonal, and hormonal factors (Beck, 1995; Leiblum & Rosen, 1988), and the present model might yield novel ways to conceptualize how and why, for example, difficulties within a romantic relationship might have a more powerful dampening effect on women's than men's subjective experiences of sexual desire.

Perhaps the most notable implication of the present model concerns gender differences in the development and expression of same-gender sexuality, which has received increasing attention in recent years (Baumeister, 2000; Diamond & Savin-Williams, 2000; Peplau & Garnets, 2000; Peplau, Spalding, Conley, & Veniegas, 1999; Savin-Williams & Diamond, 2000). For example, women show greater variability than men in the age at which they first become aware of same-gender attractions, the age at which they consciously question their sexuality, and the age at which they pursue their first same-gender sexual contact (Bell & Weinberg, 1978; D'Augelli & Hershberger, 1993; Fox, 1995; Herdt & Boxer, 1993; Sears, 1989; Weinberg et al., 1994). Many women experience these three "milestones" of sexual identity development simultaneously, late in life, in the context of an unexpected same-gender affair (Cassingham & O'Neil, 1993; Kitzinger & Wilkinson, 1995). Also, women place less emphasis on the sexual component of their lesbian or bisexual identification, both during and after the questioning process (Blumstein & Schwartz, 1993; Cass, 1990; Esterberg, 1994; Nichols, 1990; Whisman, 1996), and are more likely to report that their sexuality is fluid and chosen versus fixed and biologically given (Esterberg, 1994; Golden, 1987, 1996; Rosenbluth, 1997; Whisman, 1996).

All of these findings are consistent with the notion that interpersonal factors play a greater role in the development and expres-

sion of same-gender sexuality among women than among men. On the basis of such differences, Peplau et al. (1999) recently proposed that female same-gender sexuality might be fruitfully reconceptualized in terms of *intimate careers* rather than early-appearing, fixed traits. This conceptualization would model a woman's experiences of same-gender and other-gender sexual desires as a function of her current and prior experiences in same-gender and other-gender intimate relationships. This view does not deny potential biological contributions to women's same-gender sexual desires but grants them notably less weight in directing lifetime trajectories of intimate experience. The model presented here is consistent with this perspective and points toward some of the underlying mechanisms through which intimate careers might exert their influences.

Does this view imply that a woman's participation in intimate relationships can change her sexual orientation? The answer to this question depends on how one defines *sexual orientation*. Certainly, same-gender sexual and affectional desires undergo some change (Diamond, 2000b, in press-a; Pattatucci & Hamer, 1995; Stokes, Damon, & McKirnan, 1997; Stokes, McKirnan, & Burzette, 1993; Weinberg et al., 1994), yet such changes are usually small in magnitude and do not typically involve the complete disappearance of either same-gender or other-gender sexual or affectional feelings. Thus, perhaps it is easier to develop novel sexual desires (for either gender) than to extinguish them, a conclusion that is consistent with research on the development of bisexual attractions and identities (Fox, 1995; Weinberg et al., 1994).

A more perplexing issue concerns the long-term implications of cross-orientation affectional bonds and relationship-specific sexual desires. In some cases (as noted above), these experiences are eventually interpreted as singular, temporary aberrations; in other cases, they might be repeatedly reinforced and hence become increasingly robust over time, eventually showing the same stability traditionally expected of intrinsic same-gender desires (Cass, 1990). The inherent interconnectedness, plasticity, and developmental sensitivity of the neural circuits involved in love and desire may play a role in such phenomena. For example, Panksepp (1998) suggested that such circuits may play a role in the *mere-exposure* effect, whereby both animals and humans develop preferences for stimuli to which they have been repeatedly exposed, especially if the exposures were affectively positive (p. 259). Such processes might help to explain why some women's late-appearing, affectionally based same-gender desires often prove to be notably robust and stable (Cassingham & O'Neil, 1993). Perhaps repeated participation in affectively positive same-gender intimacy (accompanied by the release of neurochemicals that facilitate conditioning) is capable of restructuring individuals' romantic-sexual attachment schemata, such that women who do not possess a genetic orientation to the same gender might nonetheless develop comparably stable and robust predispositions for same-gender partners on the basis of multiple, affectively positive same-gender experiences.

This, of course, could also occur among men, and the specific extent to which such phenomena might be gender-differentiated is unknown. Clearly, much remains to be learned about the development and expression of both female and male same-gender sexuality. In this respect, perhaps the most important point highlighted by the model I have presented is the simple fact that same-gender

sexuality has multiple components and multiple determinants. As Bancroft (1990) noted, "the 'state of being homosexual' in our society . . . is a consequence (and not necessarily an end state) of a multifactorial developmental process" (p. 101). Furthermore, this process varies not only across but within men and women. It is hoped that the present model will provide a useful framework for future research delineating the diverse origins and implications of same-gender and other-gender desires for men and women over the life course.

Limitations of the Model

As noted repeatedly above, this model's formulation of the interacting biological underpinnings of human love and desire relies heavily on research findings from animal studies, which is perhaps its chief limitation. Given the extensive cross-species variation that has been documented in parenting behavior, pair-bonding behavior, sexual behavior, and also in the distribution and functioning of oxytocin receptors (Tribollet, Dubois-Dauphin, Dreifuss, Berberis, & Jard, 1992; Witt, 1997), definitive claims regarding the specific neurobiological underpinnings of human affect and behavior await future research. Another limitation concerns the potential for reductionism. Philosophers have debated the meaning of love for hundreds of years—is it really just a matter of neurochemistry? The qualitative experience of romantic love shows remarkable diversity across different cultures, different individuals, and different relationships within a single individual's life: What accounts for such differences? The present model does not address this complex question, and I have not systematically discussed the multiple ways in which social and cultural factors might interact with biological processes to influence subjective experiences of sexual and affectional desire. However, the disproportionate focus on biological rather than social determinants of affect and behavior should not be interpreted as biological determinism. Rather, it is intended to counterbalance the widespread assumption that whereas sexual desires belong in the realm of "nature," affectional feelings belong in the realm of "culture." I fully acknowledge, however, that biological predispositions are in constant interaction with environmental input (from individual interpersonal experiences with overarching cultural norms) and that all affective-behavioral outcomes must be viewed as products of such interactions.

For example, as reviewed by Panksepp (1998), research on rats has found that participation in sexual activity produces up to threefold increases in male rats' brain oxytocin levels, which might function to facilitate subsequent pair-bonding and parenting (although the duration of these changes and their specific behavioral effects await future study). Such findings demonstrate that in the realm of human social behavior, the nature-nurture dichotomy is not only unpalatable but inaccurate. The available evidence suggests that "the environment" (whether an entire society or a single interpersonal relationship) is not simply layered on top of biological processes but becomes fundamentally integrated into these processes through direct experience (Money, 1988).

Given this fact, one might argue that it is too simplistic to view sexual desire as intrinsically oriented by genetic factors. I share this reservation. As noted above, although there is both a plausible evolutionary basis for sexual desires to be heterosexually oriented for most individuals, and empirical evidence that nonheterosexual

orientations are partially genetic, this does not prove that sexual desires themselves are intrinsically gender coded. As noted above, it is not yet clear what the genes in question code for. The present model therefore takes a stronger stand for the absence of gender coding in romantic love than the presence of gender coding in sexual desire. Its strongest stand is that however sexual desires come to be channeled in one direction or another—whether through genes, perinatal hormonalization, or early learning—these processes impose no de facto constraints on affectional bonding.

Conclusion

In critiquing the overemphasis on physical, mechanical aspects of sexuality that characterized most basic research on sexual orientation, DeCecco (1990) pointed out that such models are incapable of accounting for phenomena such as the “delight in hearing the soothing sound of your partner’s voice” (p. 372). Although few would argue that such phenomena are unrelated to sexuality and sexual orientation, such experiences have nonetheless received short shrift by researchers investigating the nature, origin, and development of same-gender sexuality. As a result, the most we have been able to say about the association between same-gender sexual and affectional feelings is that they are somehow related yet somehow distinct.

Given the current state of knowledge regarding the evolutionary bases of affectional bonding and their underlying psychobiological mechanisms, this vagueness should no longer be tolerated. Whereas previous investigations of the nature and origin of same-gender sexuality have tended to view affectional bonds as the environmental wrapping around a core of biologically mediated sexual desire, it is now abundantly clear that affectional bonds, too, are biologically mediated phenomena that are as much a part of the evolved system of human mating as libido. The next generation of research on sexual orientation must take this into account. Greater attention to processes of affectional bonding may significantly advance our understanding of how and why individuals show such diverse patterns of desire, infatuation, and love for same-gender and other-gender partners over their lifetimes.

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