

Romantic Love and Sexual Desire in Close Relationships

Gian C. Gonzaga
University of California, Los Angeles

Rebecca A. Turner
Alliant International University and University of California,
San Francisco

Dacher Keltner
University of California, Berkeley

Belinda Campos
University of California, Los Angeles

Margaret Altemus
Weill Medical College, Cornell University

Drawing on recent claims in the study of relationships, attachment, and emotion, the authors hypothesized that romantic love serves a commitment-related function and sexual desire a reproduction-related function. Consistent with these claims, in Study 1, brief experiences of romantic love and sexual desire observed in a 3-min interaction between romantic partners were related to distinct feeling states, distinct nonverbal displays, and commitment- and reproductive-related relationship outcomes, respectively. In Study 2, the nonverbal display of romantic love was related to the release of oxytocin. Discussion focuses on the place of romantic love and sexual desire in the literature on emotion.

Keywords: romantic love, sexual desire, emotion, facial expression, relationship functioning

The study of emotions in close relationships has yielded two complementary insights. First, emotions and their many manifestations are profoundly relational: They occur, in significant part, to coordinate social interactions within relationships (e.g., Tiedens & Leach, 2004). Second, emotions expressed by individuals shape the content and direction of relationships. For example, the occurrence of brief emotions such as contempt or amusement reveals a great deal about the likelihood that a couple will stay together or dissolve (Gottman & Levenson, 2000).

In this article, we present two studies that examine the forms and functions of romantic love and sexual desire in romantic relationships. Following Diamond (2003, 2004), we define romantic love as a motivational state associated with feelings of attachment and the inclination to seek commitment with one partner, and we define sexual desire as a motivational state that leads the individual

to seek opportunities for sexual activity. We rely on the methods of affective science—the study of subjective experience, communicative display, relational outcomes, and physiological markers—to test hypotheses about the distinct functions of romantic love and sexual desire. In the General Discussion, we address the question of whether romantic love and sexual desire are emotions.

Romantic Love and Sexual Desire as Separate Relational Processes

Two schools of thought converge on the notion that romantic love and sexual desire are independent relational processes. Relationship researchers have long grappled with the question of how romantic love and sexual desire emerge and evolve over the course of intimate relationships (Aron & Aron, 1998; Hatfield, 1988;

Gian C. Gonzaga and Belinda Campos, Department of Psychology, University of California, Los Angeles; Rebecca A. Turner, California School of Professional Psychology, Alliant International University, and Department of Psychiatry, University of California, San Francisco; Dacher Keltner, Department of Psychology, University of California, Berkeley; Margaret Altemus, Weill Medical College, Cornell University, New York.

Gian C. Gonzaga is now at eHarmony Labs, eHarmony.com, Pasadena, CA.

This work was based, in part, on Gian C. Gonzaga's dissertation and was partially supported by National Institute of Mental Health Postdoctoral Training Grant 5T32MH15750-22 to Gian C. Gonzaga. Study 2 was carried out in the General Clinical Research Center, Moffitt Hospital, University of California, San Francisco, with funds provided by National Center for Research Resources Grant 5 MO1 RR-00079 from the U.S. Public Health Service. Funds were also provided by an institutional grant from the California School of Professional Psychology to Rebecca A. Turner.

We thank Bijan Navidi, Courtney Childress, Nicholas Sobbe, Nicole Buisson, Ember Lee, and Tiffany Fong for their efforts in coding the videotapes in Studies 1 and 2. We also thank Jennifer Berdahl, Paige Daniel, Tara Gruenewald, Oliver John, Gerald Mendelsohn, Frances Northcutt, Anne Peplau, Heather Setrakian, Shelley Taylor, John Updegraff, and Leah Walling for comments on versions of this article. We thank Teresa Enos for acting as project coordinator and interviewer, Julie Gross for participant recruitment, and Paul Ekman and Sue Carter for valuable consultation on the procedure of Study 2.

Correspondence concerning this article should be addressed to Gian C. Gonzaga, eHarmony Labs, eHarmony.com, 888 East Walnut Street, Suite 200, Pasadena, CA 91106. E-mail: giangonzaga@eharmony.com. Correspondence specifically concerning Study 2 should be addressed to Rebecca A. Turner, California School of Professional Psychology, Alliant International University, 1 Beach Street, Suite 100, San Francisco, CA 94133. E-mail: rturner@alliant.edu

Hatfield & Rapson, 1993; Hatfield & Walster, 1978; S. S. Hendrick & Hendrick, 1992; R. J. Sternberg, 1986). Within this tradition, researchers differentiate between companionate love (or romantic love, in our terminology), which involves deep feelings of commitment, intimacy, and connection, and passionate love (or sexual desire, in our terminology), which involves powerful feelings of attraction, desire, passion, and infatuation (Diamond, 2003; Hatfield, 1988; Hatfield & Rapson, 1993; Reis & Shaver, 1988).

Within this framework, romantic love fulfills a commitment role, sustaining long-term bonds by promoting intimacy, connection, and the formation of mutual long-term plans (e.g., Aron & Aron, 1998; Diamond, 2003; Dion & Dion, 1973; Ellis & Malamuth, 2000; Hatfield & Rapson, 1993; S. S. Hendrick & Hendrick, 1992; R. J. Sternberg, 1986). In line with this thesis, romantic love relates to an interest in being close to a partner (Aron & Aron, 1998; Hatfield, 1988; Hatfield & Walster, 1978) and encourages self-disclosure (Aron, Norman, Aron, McKenna, & Heyman, 2000; S. S. Hendrick, Hendrick, & Adler, 1988; Wieselquist, Rusbult, Foster, & Agnew, 1999). Moreover, the feeling of falling in love involves a rapid expansion of the self to include the partner (Aron & Aron, 1997), and perceptions of increasing love across the duration of a relationship predict later relationship continuation (Sprecher, 1999).

In contrast, sexual desire—and related feelings of passion and infatuation—fulfill an initiation role, motivating sexual interest, proximity seeking, and initial contact. By motivating proximity seeking, sexual desire promotes contact and allows commitment to grow (e.g., Hazan & Zeifman, 1994, 1999; Zeifman & Hazan, 1997). In line with this thesis, passion—or sexual desire—tends to peak early in a relationship (Aron & Aron, 1991; Berscheid, 1985; Regan, 1998; R. J. Sternberg, 1986), and behaviors motivated by sexual desire, such as sexual contact or certain kinds of touch, are less frequent in more established relationships (Sprecher & Regan, 1998).

Evolutionary and attachment-related accounts of relationships have similar claims about romantic love and sexual desire (e.g., Diamond, 2003; Fisher, 1998; Hazan & Shaver, 1987). Romantic love is thought to be part of a pair-bonding system, which keeps partners together in long-term relationships that are oriented toward raising vulnerable, dependent offspring to the age of viability (Buss, 1988, 1994; Buss & Schmitt, 1993; Fisher, 1998; Kenrick & Trost, 1997; Simpson, 1994). As a part of the mating system and with the primary goal of reproduction, sexual desire responds to cues of reproductive readiness, such as physical markers of fertility or status (Buss, 1994).

This evolutionary, attachment-related approach is best encapsulated in Diamond's (2003, 2004) biobehavioral model of romantic love and sexual desire. Diamond argued that romantic love and sexual desire serve different functions, namely to promote pair bonding and sexual behavior, respectively. In support of these claims, Diamond reviewed evidence showing that the subjective experiences of romantic love and sexual desire are functionally independent: Individuals can feel romantic love but not sexual desire, or sexual desire but not romantic love, toward another person. Romantic love and sexual desire, Diamond claimed, also appear to be mediated by different physiological processes: oxytocin (OT) and endogenous opioids in the case of romantic love, and gonadal estrogens and androgens in the case of sexual desire.

Across these schools of thought, romantic love and sexual desire are treated both as enduring sentiments and as brief emotional responses (e.g., Aron & Aron, 1998; Diamond, 2003; Diamond, L. M. 2004; Hatfield & Rapson, 1993; R. J. Sternberg, 1986). That is, romantic partners will feel enduring yet shifting levels of romantic love and sexual desire toward one another over the course of their relationship. In addition, they will feel momentary surges of romantic love and sexual desire, which could be thought of as emotional experiences. This distinction between enduring sentiment, or disposition, and brief emotional experience is seen elsewhere in discussions of traits and states (e.g., Malatesta, 1988; Rosenberg, 1998). For example, traits such as hostility and neuroticism have enduring dispositional characteristics—for example, the general tendency to feel irritable or tense and anxious—and also manifest in brief emotional experiences, such as anger or fear. In the present study, we examine brief occurrences of romantic love and sexual desire.

Romantic Love and Sexual Desire Within a Social Functional Approach to Emotion

Social functional accounts of emotion maintain that emotions coordinate interpersonal interactions. These interactions are the building blocks for relationships that are critical to survival, reproduction, and the raising of offspring (Frijda & Mesquita, 1994; Keltner & Haidt, 2001; Nesse, 1990). The different response systems of emotion are thought to serve fairly specific functions within social interactions (for a review, see Keltner & Haidt, 1999, 2001). The experiential component of emotion signals important states of affairs to the individual and motivates goal-directed behavior (Buck, 1999; Frijda, 1988; Schwarz & Clore, 1996). Certain responses in the autonomic nervous system help support different actions, such as soothing or fleeing. In addition, the expressive display of emotion rapidly communicates information about the internal state of the sender, objects and events in the environment, and the status of the relationship between the sender and the receiver (e.g., Keltner & Kring, 1998).

In situating emotions within social interactions, social functional accounts have prioritized states that are relational in nature but often on the margins of earlier emotion theory. Thus, guided by some of the assumptions of a social functional approach to emotion, researchers have recently examined embarrassment (Keltner & Buswell, 1997), shame (Tangney, Miller, Flicker, & Barlow, 1996), jealousy (Buss, Larsen, Westen, & Semmelroth, 1992), gratitude (McCullough, Kilpatrick, Emmons, & Larson, 2001), awe (Keltner & Haidt, 2003), and compassion (Goetz & Keltner, 2005). Several theorists have proposed that, as emotions, romantic love and sexual desire serve commitment- and reproduction-related functions, respectively, within short-term, romantic interactions (Gonzaga, Keltner, Londahl, & Smith, 2001; Keltner & Haidt, 2001; Shaver, Hazan, & Bradshaw, 1988). By implication, brief occurrences of romantic love and sexual desire should be associated with different experiences, displays, and physiological processes that serve pair-bonding and reproductive functions, respectively.

Empirical Studies of Romantic Love and Sexual Desire

Is there evidence that differentiates brief occurrences of romantic love from those of sexual desire? To our knowledge, the answer

is no. Select studies have assessed romantic love and sexual desire with self-report scales, treating romantic love and sexual desire as global sentiments that generalize across time and context. Subscales of the Triangular Love Scale (Sternberg, 1997) that measure intimacy and passion commonly correlate at .60 or higher (Chojnacki & Walsh, 1990; D. P. Sternberg, 1997; Whitley, 1993). Aron and Westbay (1996) cluster analyzed the 68 prototypical features of love studied by Fehr and Russell (1991) and found three clusters of items, which they named passion, intimacy, and commitment. The passion and intimacy clusters correlated around .30. Scales measuring *storge* (love with sexual desire relatively absent) and *eros* (love with sexual desire present) are virtually uncorrelated (C. Hendrick & Hendrick, 1986). This work suggests that romantic love and sexual desire may or may not be positively correlated during spontaneous experience.

In another line of inquiry, researchers have explored the content of emotion categories. Typically, people nominate love as a prototypical emotion, and sexual desire emerges as a component of love or as only weakly representative of the prototype of love (Fehr & Russell, 1984, 1991; Shaver, Schwartz, Krison, & O'Connor, 1987). For example, in one study, participants organized 135 emotion words into categories. A cluster analysis revealed five categories, one of which the researchers named *love*, which included subordinate categories labeled *affection* (i.e., romantic love) and *lust* (i.e., sexual desire; Shaver et al., 1987). In another study of this variety, participants were asked to exclude emotion terms that they believed did not belong in the category of love. Few participants excluded the words *love* (2%), *caring* (8%), and *affection* (27%). Many participants excluded the words *desire* (59%), *infatuation* (82%), and *lust* (87%; Fehr & Russell, 1991). In another study, participants wrote lists of people toward whom they currently felt "love" and those toward whom they currently felt "sexual attraction/desire." These categories only partially overlapped, which suggests that love and sexual desire can occur independently of each other (Myers & Berscheid, 1997). Taken together, these studies of emotion lexicon and knowledge suggest that romantic love and sexual desire are often only partially overlapping in people's intuitive conceptions. However, none of these studies has measured the experience of romantic love and sexual desire as momentary states during spontaneous interaction.

The Current Investigation

Guided by criteria used to differentiate emotions (Ekman, 1992; Keltner & Buswell, 1997), in the present investigation we examine whether brief occurrences of romantic love and sexual desire are associated with differing experiential correlates, communicative displays, relationship outcomes, and physiological markers. In Study 1, we used the spontaneous interactions of romantic partners. In Study 2, we studied women as they relived an intense emotional experience. Whereas in some contexts one is likely to observe either romantic love or sexual desire in the absence of the other, in our two experimental contexts we expected romantic love and sexual desire to covary (Diamond, 2003). Evidence differentiating romantic love from sexual desire in a context in which both emotions occur is a stringent test of the claim that the two states are distinct. In light of this, in Study 1 we investigated the experience of romantic love and sexual desire during a 3-min interac-

tion between young romantic partners with respect to commitment and sexuality.

Study 1: Romantic Love and Sexual Desire in Spontaneous Interactions Between Romantic Partners

The claim that romantic love serves a pair-bonding or commitment function, whereas sexual desire serves a reproductive function, led to three hypotheses that we test in Study 1. First, we expected self-reports of romantic love to correlate with positive/approach-related states more than sexual desire, which we expected to more strongly correlate with reports of arousal (Allen, Kenrick, Linder, & McCall, 1989; Dutton & Aron, 1974; White, Fishbein, & Rutstein, 1981).

Our second prediction was that romantic love and sexual desire would be associated with distinct nonverbal displays, a claim that requires three kinds of evidence (see Ekman, Friesen, & Ellsworth, 1972; Keltner, 1995). One must establish that the experience of that emotion is encoded into a distinct pattern of behavior (encoding evidence), that this display is reliably interpreted by an observer (decoding evidence), and that the experience–display link for an emotion is not observed in closely related states (divergent evidence). In initial work, Gonzaga et al. (2001) found, in two encoding studies, that *affiliation cues*, including affirmative head nods, Duchenne smiles, positive gesturing with the hands, and leaning toward the partner, correlated with self-reports of love but not desire (see also Andersen, Andersen, & Jensen, 1979; Burgoon, 1991; Burgoon, Buller, Hale, & deTurck, 1984; Dittman, 1972; Matarazzo, Weins, & Saslow, 1965; Mehrabian, 1971; Mehrabian & Williams, 1969; Rosenfeld, 1966a, 1966b; Trout & Rosenfeld, 1980). In a forced choice decoding study, naive observers consistently labeled a set of *sexual cues* (i.e., licking, puckering, touching the lips, tongue protrusions) as desire and affiliation cues as love.

In the present study, we extend this work in two ways. First, the initial Gonzaga et al. (2001) study was conducted largely with Caucasian participants. In the present study, we test our hypotheses regarding romantic love and sexual desire across three ethnic groups—Asian American, Caucasian, and Latino couples—for purposes of generalizability across cultures. Previous work has shown some variation in emotional judgments, display rules, and self-reported emotional expression among Asians, Caucasians, and Latinos in the United States (Matsumoto, 1993; Tsai, Chentsova-Dutton, Freire-Bebeau, & Przymus, 2002; Tsai & Levenson, 1997).

Second, we provide encoding evidence for a distinct display of sexual desire. To do this, we focus on four sexual cues examined in decoding studies presented by Gonzaga et al. (2001): licking, puckering, and touching the lips as well as protruding the tongue (for other studies linking these cues to sexual desire in human and other primates, see Carpenter, 1934; Chevalier-Skolnikoff, 1971; Eibl-Eibesfeldt, 1974, 1989; Epple, 1967; Givens, 1978; Gonzaga et al., 2001; Grammer, 1990; Kendon, 1975; McCormick & Jones, 1989; Moore, 1985; Reynolds & Reynolds, 1965; Tokuda, Simons, & Jensen, 1968). We also test two additional cues that have been linked to sexual desire: biting the lips (Givens, 1978) and sucking the lips so they are rolled into the mouth (Kendon, 1975). Our second hypothesis holds that affiliation cues will correlate with self-reports and partner attributions of love but not sexual desire,

whereas sexual cues will correlate with the experience and partner attributions of sexual desire but not love.

Our third and final hypothesis holds that the brief experiences of romantic love and sexual desire will correlate with commitment- and reproduction-related outcomes, respectively. In particular, we predict that the momentary experience of love will relate to reports of increased commitment and perceptions that the partner has interest in maintaining the romantic bond. We expect the momentary experience of sexual desire, in contrast, to relate to sexual satisfaction in the relationship, perception of sexual intent in a partner, and reports of sexual behavior between partners.

Method

Participants

We recruited 63 heterosexual romantic couples from the University of California, Berkeley, and surrounding communities via flyers, the psychology department participant pool, and university organizations (e.g., sororities, cultural groups). We selected couples to participate if they had been monogamous for at least 3 months and both members of the couple were Asian (24 couples), Caucasian (25 couples), or Latino (14 couples). We determined ethnicity by self-reported ethnic categorization and open-ended ethnic identification. On average, women were 20.4 years old ($SD = 3.59$), men were 21.3 years old ($SD = 4.04$), and the couples had been dating 17.6 months, with a range of 3 to 60 months. Across the three ethnic groups, there were no differences in the average age of the participants or the amount of time the couple had been dating. All procedures were approved by the university's institutional review board.

Procedure

Couples were brought into the laboratory and signed consent forms together. Sessions lasted approximately 1.5 hr. During the first 45 min, participants filled out demographic, personality, and relationship questionnaires in separate rooms. They were then reunited in a video laboratory and seated across from each other. During the second 45 min of the study, couples participated in a videotaped interaction session. They were then debriefed and dismissed. Participants either received credit for a participant pool requirement or were paid between \$15 and \$25 each for their participation.

Videotaping of semistructured, spontaneous interactions. Behind each participant, a small video camera was mounted in the top shelf of a bookcase behind a clear glass cover. The cameras captured images of the participants from their upper torso to the top of their head. Experimenters, in an adjacent recording room, controlled the movement of the cameras and spoke to the participants via an intercom. Two experimenters were present during each session; one interacted with the participants, and the other controlled the cameras. Six experimenters conducted sessions (four women and two men), including Gian C. Gonzaga and Belinda Campos. During the 45-min videotaped interaction, couples engaged in four semistructured interactions that were designed to elicit fairly distinct emotions: (a) They teased one another (to elicit embarrassment and amusement), (b) they talked about a current concern (to elicit anxiety in the speaker and sympathy in the listener), (c) they talked about a past intimate relationship (to elicit jealousy), and (d) they talked about their first date (to elicit romantic love and sexual desire). We focused our analyses on the first date discussion, because it was designed to elicit romantic love and desire (see Table 1) and because the emotions the participants felt and displayed were about each other rather than other intentional objects, such as a past romantic partner (in the past partner discussion) or the future (the most typical topic in the current concern discussion).

Table 1
Means and Standard Deviations of Self-Reported Love and Desire and of Affiliation and Sexual Cues Displays

| Self-report and cue display | Women | | Men | | Sex difference |
|-----------------------------|----------|-----------|----------|-----------|----------------|
| | <i>M</i> | <i>SD</i> | <i>M</i> | <i>SD</i> | |
| Self-reported love | 5.33 | 2.53 | 5.57 | 2.64 | <i>ns</i> |
| Partner-estimated love | 5.14 | 2.57 | 5.49 | 2.49 | <i>ns</i> |
| Self-reported desire | 1.90 | 2.18 | 1.81 | 2.12 | <i>ns</i> |
| Partner-estimated desire | 1.95 | 2.18 | 1.78 | 2.24 | <i>ns</i> |
| Affiliation cue display | 15.33 | 18.71 | 8.80 | 12.37 | $p < .05$ |
| Affirmative head nods | 1.24 | 2.28 | 0.85 | 1.56 | <i>ns</i> |
| Duchenne smiles | 4.40 | 4.86 | 2.69 | 3.45 | $p < .05$ |
| Gesticulation | 3.86 | 8.38 | 2.09 | 3.18 | <i>ns</i> |
| Lean toward partner | 5.82 | 15.91 | 3.17 | 10.86 | <i>ns</i> |
| Sexual cue display | 0.63 | 1.08 | 1.57 | 3.91 | $p < .07$ |
| Lip bite | 0.12 | 0.35 | 0.11 | 0.57 | <i>ns</i> |
| Lip lick | 0.14 | 0.40 | 0.31 | 0.62 | $p < .05$ |
| Lip suck | 0.15 | 0.51 | 0.16 | 0.59 | <i>ns</i> |
| Lip touch | 0.17 | 0.58 | 0.97 | 3.76 | <i>ns</i> |
| Tongue protrusion | 0.06 | 0.20 | 0.02 | 0.09 | <i>ns</i> |

Note. Sex differences were tested via a paired samples *t* test. Cue displays are represented in seconds displayed per minute of couple interaction.

First date discussion. Participants were asked to have a conversation about their first date. Discussions took between 1 and 8 min and averaged 3 min 15 s. Couples most often discussed what they considered to be their first date, why they considered it their first date, what they did on that date, and how that date changed their relationship.

Teasing exercise. To facilitate teasing, we gave participants a set of initials (A. D. or L. I.) and told them to create a nickname for their partner using the initials and a story justifying the nickname (see Keltner, Young, Heerey, Oemig, & Monarch, 1998). We gave participants a few minutes to generate their nicknames and stories and a piece of scratch paper to jot down notes. Participants then took turns delivering their nickname and story to each other. Order of teasing was determined randomly. After the teasing interaction, participants rated how much their partner's tease was motivated by the desire to (a) emphasize the closeness of the relationship and (b) express romantic or sexual attraction, on a scale from 1 = *not a motive at all* to 7 = *a very strong motive*.

Emotion report. At the start of the first videotaped interaction and after each interaction, participants reported their own emotions and estimated their partner's emotions on a scale from 0 = *no emotion* to 8 = *extreme emotion*. To gain reports of the momentary experience of emotion that we could link to expressive display, we had participants report how much of each emotion they felt during the discussion they had just completed. Participants reported on the following emotions: amusement, anger, anxiety, arousal, concern, contempt, desire, discomfort, disgust, embarrassment, fear, guilt, happiness, jealousy, love, pride, sadness, shame, shyness, sympathy, and tension.

Measures

Demographics. Participants reported their gender, age, and ethnic group, and they also provided an open-ended report of the ethnic group with which they most identified.

Attachment. Participants completed the 36-item Experiences in Close Relationships measure of adult attachment (Brennan, Clark, & Shaver, 1998). This scale measured attachment avoidance ($\alpha = .90$) and attachment anxiety ($\alpha = .90$).

Commitment. Participants reported (a) the number of months they had dated; (b) whether they had discussed marriage, as measured by a *yes/no* item and on a scale from 1 = *not at all* to 7 = *a lot*; (c) how much they had discussed the future of the relationship; (d) how committed the relationship was; and (e) whether they were in love with their partner. The final three questions were averaged into a single measure of commitment ($\alpha = .78$).

Sexual satisfaction and sexual behavior. The following three items were standardized and averaged to create a scale of sexual satisfaction ($\alpha = .76$): (a) how much participants agreed about sexual relations with their partner (1 = *always disagree*, 6 = *always agree*), (b) how enjoyable they found their sexual relations with their partner (1 = *not at all enjoyable*, 5 = *very enjoyable*), and (c) how satisfactory they found the sexual relations with their partner (1 = *not at all*, 4 = *very*). In addition, each participant indicated (a) how often he or she used sex or physical affection as a relationship influence tactic (1 = *never*, 5 = *always*) and (b) how often his or her partner used sex or physical affection as a relationship influence tactic (1 = *never*, 5 = *always*). Finally, couples also reported whether they currently engaged in sexual intercourse (*yes/no*).

Coding of Affiliation and Sexual Cues

From the first date discussion, we coded affiliation and sexual cues during one randomly selected minute of the couple's conversation, given the laborious nature of the coding and previous studies attesting to the predictive power of limited samples of intensively coded nonverbal behavior (Gonzaga et al., 2001; Keltner & Bonanno, 1997; Keltner, Moffitt, & Stouthamer-Loeber, 1995). One judge, Gian C. Gonzaga, who was unaware of the couples' reports of love and desire, coded the occurrence and duration of the four affiliation cues and the six sexual cues. A second judge, unaware of the study hypotheses and the couples' reports of love and desire, coded a random subset of 35% of the couples (22 couples) to establish reliability. If both judges agreed that the same cue was present during the same second or that no cues were present during the same second, we coded this as agreement. If one judge coded the occurrence of one behavioral cue that the other judge did not code during the same second, we coded this as disagreement. Overall, the two judges agreed 94.2% of the time ($\kappa = .74$). Codings for the Duchenne smile and the lip pucker were based on the criteria established by Ekman and Friesen's (1978) Facial Action Coding System. With respect to the Duchenne smile, judges were trained to code the co-occurrence of the actions of the orbicularis oculi muscle (AU6) and the zygomatic major muscle (AU12). The criteria for coding the remainder of the cues were based on the studies of affiliation and sexual cues cited in the introduction. Behaviors were coded, in seconds, from their onset time (the first visible evidence of the behavior) to their offset time (when the behavior was no longer visible).

Results

Overview of Analyses

Table 1 presents the means and standard deviations of self-reports and partner estimates of love and desire gathered directly after the 3-min first date discussion, as well as the mean display times for affiliation and sexual cues in seconds per minute. In an analysis of these measures, two sex differences emerged. Women displayed more affiliation cues than men, $t(61) = 2.29, p < .05$, driven largely by a difference in smiling (e.g., LaFrance, Hecht, & Paluck, 2003). In addition, men tended to display slightly more sexual cues than women, $t(61) = 1.86, p < .10$, which could be viewed as supportive of evolutionary claims regarding gender and sexual interest (Buss & Schmitt, 1993). There were no differences across ethnic groups in the amount of love or desire reported nor

in the amount of affiliation and the number of sexual cues displayed. The lip pucker was displayed only once, and we therefore dropped it from further analyses. We averaged the standardized duration scores of the four affiliation cues to create a composite measure of affiliation cues and averaged the five sexual cues to create a composite measure of sexual cues. Because each participant's data were dependent on her or his partner's data, we treated the dyad as the unit of analysis by averaging the couple's scores on each of their measures. Although this is not the optimal method to analyze dyadic data, we selected it for two reasons. First, because there were only two data points per couple (female and male), using multilevel modeling was problematic. Second, many of our measures of nonverbal behavior were not normally distributed, thus violating a basic assumption necessary to conduct structural equation modeling.

As one might expect, couples' reports of love and desire were significantly and positively related, self-report, $r(63) = .45, p < .001, r^2 = .206$; partner estimates, $r(63) = .42, p < .001, r^2 = .177$. In light of this correlation, we tested some of our hypotheses with partial correlations, relating reports of love and desire to the dependent measures of interest and controlling for the other emotion. These analyses represent strong tests of our hypotheses, because we removed a significant amount of reliable variance in each emotion measure and performed statistical tests with one fewer degree of freedom. To be complete, we report the zero-order correlations in the relevant table of results. Effect sizes are presented in squared correlation or eta-squared. By the standards of Cohen (1988, 1992), a small effect is .01, a medium effect is .09, and a large effect is .25.

Do Love and Sexual Desire Have Distinct Emotional Correlates?

Our first hypothesis was that the experience of love would relate to positive, approach-related emotions (i.e., happiness) more so than desire, which we expected to relate to arousal more so than love. The zero-order and partial correlations presented in Table 2 provide partial support for this hypothesis: Self-reports of love gathered after the first date discussion were most strongly correlated with happiness, $r(62) = .60, r^2 = .36$, whereas desire was most strongly correlated with arousal, $r(62) = .78, p < .001, r^2 = .58$. We used the Hotelling's t test for nonindependent correlations to assess whether the correlations between love and desire and other states differed statistically (Rosenthal & Rosnow, 1991). As shown in the third column of Table 2, reports of love tended to be more strongly associated with reports of happiness than were reports of desire, $t(60) = 1.83, p < .08$, which were more strongly associated with reports of arousal than were reports of love, $t(60) = 5.29, p < .001$.

In Table 2 one also sees that self-reports of love correlated positively with amusement, arousal, and pride and negatively with anger, discomfort, disgust, and sadness. Reports of desire correlated positively with amusement, concern, happiness, and pride. We observed significant differences in the correlations of love and desire with other states for concern, fear, jealousy, sadness, shyness, and sympathy.

Table 2
Zero-Order and Partial Correlations of Love and Desire With Other States

| State | Zero-order correlations | | | Partial correlations | |
|------------------|-------------------------|--------------|------------|----------------------|--------------|
| | Love | Desire | Difference | Love | Desire |
| Amusement | .40** | .26* | <i>ns</i> | .32* | .10 |
| Anger | -.30* | -.13 | $p < .10$ | -.27* | .00 |
| Anxiety | .00 | .10 | <i>ns</i> | -.05 | .11 |
| Arousal | .37** | .80** | $p < .001$ | .01 | .76** |
| Concerned | .00 | .35* | $p < .05$ | -.19 | .39** |
| Contempt | -.06 | -.11 | <i>ns</i> | -.01 | -.09 |
| Discomfort | -.27* | -.16 | <i>ns</i> | -.22 | -.04 |
| Disgust | -.27* | -.07 | $p < .07$ | -.27* | .06 |
| Embarrassment | .03 | -.03 | <i>ns</i> | .04 | -.04 |
| Fear | -.10 | .18 | $p < .05$ | -.21 | .25* |
| Guilt | .06 | .18 | <i>ns</i> | -.03 | .17 |
| Happiness | .69** | .52** | $p < .08$ | .60** | .31* |
| Jealousy | -.15 | .10 | $p < .05$ | -.23 | .20 |
| Pride | .43** | .55** | <i>ns</i> | .24 | .44** |
| Sadness | -.30* | .01 | $p < .01$ | -.34* | .17 |
| Shame | -.06 | -.02 | <i>ns</i> | -.06 | .01 |
| Shyness | .22 | -.03 | $p < .05$ | .26* | -.15 |
| Sympathy | -.08 | .16 | $p < .05$ | -.17 | .22 |
| Tension | -.09 | .06 | <i>ns</i> | -.13 | .11 |

Note. Our predicted effects are shown in boldface.

* $p < .05$. ** $p < .01$.

Do Love and Sexual Desire Have Distinct Nonverbal Displays?

Our hypothesis that romantic love and sexual desire have distinct expressive displays yielded three predictions. First, romantic partners' self-reports of love and desire should positively relate to their display of affiliation cues and sexual cues, respectively (encoding evidence). Second, romantic partners' estimates of love and desire should positively relate to their partner's display of affiliation and sexual cues, respectively (decoding evidence). Finally, romantic partners' self-reports and partner estimates of emotions other than love (i.e., desire, happiness) should not positively relate to affiliation cues, and romantic partners' self-reports and partner estimates of emotions other than desire (i.e., love, arousal) should not positively relate to sexual cues (divergent validity).

Table 3
Zero-Order and Partial Correlations Between Emotion Self-Reports and Cue Displays

| Type of prediction and report | Love | | Desire | | Happiness | | Arousal | |
|-------------------------------|-------------|-------------|-------------|--------------|------------|---------|------------|---------|
| | Zero order | Partial | Zero order | Partial | Zero order | Partial | Zero order | Partial |
| Predictor of affiliation cues | | | | | | | | |
| Self-report | .26* | .28* | .06 | -.11 | .17 | .04 | .20 | .08 |
| Partner estimate | .25* | .21 | .17 | .05 | .10 | .00 | .13 | .08 |
| Predictor of sexual cues | | | | | | | | |
| Self-report | -.01 | -.19 | .30* | .34** | -.03 | -.23† | .14 | -.09 |
| Partner estimate | -.01 | -.17 | .31* | .34** | -.04 | -.07 | -.22 | -.32* |

Note. Predicted effects are shown in boldface.

† $p < .10$. * $p < .05$. ** $p < .01$.

Controls. In our partial correlations, when we tested the relationship between love and the display of affiliation cues, we controlled for reports of desire and the display of sexual cues. When we tested for the relationship between love and sexual cues, we controlled for reports of desire and affiliation cues. When we tested for the relationship between desire and sexual cues, we controlled for reports of love and the display of affiliation cues. Finally, when we tested for the relationship between desire and affiliation cues, we controlled for reports of love and the display of sexual cues.

Divergent validity. If affiliation cues communicate love and sexual cues communicate desire, then the display of these cues should not relate to other emotional states. If, for example, the display of affiliation cues is related to happiness (which is a possibility, considering the substantial correlation between happiness and love), one partner may be signaling love, but the other partner might be interpreting such displays as happiness. Thus, it is important to show that affiliation cues relate only to the communication of love and that sexual cues relate only to the communication of desire. Given the strong correlations we observed between reports of love and happiness and between reports of desire and arousal, we considered that love and happiness as well as desire and arousal might share similar nonverbal signals. To test this possibility, we related happiness to affiliation cues, controlling for love, and arousal to sexual cues, controlling for desire.

Affiliation cues and love. The zero-order and partial correlations presented in Table 3 lend support to the hypothesis that love has a distinct nonverbal display. Affiliation cue displays were significantly and positively correlated with self-reports of love, $r(59) = .28, p < .05, r^2 = .08$, and these cues did not significantly correlate with self-reports of desire, happiness, or arousal, which suggests that affiliation cues related uniquely to love. The zero-order correlation between love reports and affiliation cues was not larger than the zero-order correlation between desire reports and affiliation cues. We also ran partial correlations controlling for length of relationship. This did not alter the magnitude or significance of the results.

Sexual cues and desire. Table 3 also shows that sexual cue displays were significantly and positively correlated with self-reports of desire, $r(59) = .34, p < .01, r^2 = .12$, and partner estimates of desire, $r(59) = .34, p < .01, r^2 = .12$, as expected. Sexual cue displays did not significantly correlate with self-reports of love, happiness, or arousal, with two exceptions: Sexual cues

Table 4
Zero-Order and Partial Correlations Between Self-Reports of Love, Desire, Commitment, and Sexual Behavior

| Self-report | Zero order | | | Partial | |
|--------------------------------------|--------------|-------------|------------|--------------|-------------|
| | Love | Desire | Difference | Love | Desire |
| Relationship commitment | .54** | .02 | $p < .001$ | .60** | -.30* |
| Sexual satisfaction | .12 | .32* | <i>ns</i> | -.01 | .34* |
| Use of sex to influence relationship | | | | | |
| Self-reported use | -.06 | .26* | $p < .05$ | -.21 | .32* |
| Perception of partner use | -.09 | .22† | $p < .05$ | -.22† | .29* |
| Perceived partner teasing motives | | | | | |
| Express sexual attraction | .21† | .34* | <i>ns</i> | .07 | .28* |
| Emphasize closeness of relationship | .43** | .09 | $p < .01$ | .44** | -.13 |

Note. Predicted effects are shown in boldface.

† $p < .10$. * $p < .05$. ** $p < .01$.

were negatively correlated with self-reports of happiness and partner estimates of arousal. The zero-order correlation between desire reports and sexual cues was significantly larger than the correlation between love reports and sexual cues, self-report, $t(64) = 2.45, p < .05$; partner estimates, $t(64) = 2.54, p < .05$. We also ran partial correlations controlling for length of relationship. This did not alter the magnitude or significance of the results.

Do Romantic Love and Sexual Desire Differentially Relate to Measures of Relationship Commitment and Sexual Satisfaction and Behavior?

Table 4 presents the zero-order and partial correlations of couples' self-reports of love and desire with measures of relationship commitment and sexual satisfaction. Love was related to greater commitment, $r(60) = .60, p < .001, r^2 = .36$, and reports that the partner's teasing behavior was motivated to emphasize the closeness of the relationship, partial $r(60) = .44, p < .01, r^2 = .19$. Furthermore, as Figure 1 illustrates, couples who discussed marriage with each other reported more love than couples who did not discuss marriage, after we controlled for desire, $F(1, 60) = 15.64, p < .001, \eta^2 = .21$. Hotelling's t tests revealed that self-reports of love correlated more strongly than self-reports of desire with the measure of relationship commitment, $t(64) = 4.79, p < .001$, and with the perception that the partner's tease was motivated to enhance closeness, $t(64) = 2.81, p < .01$.

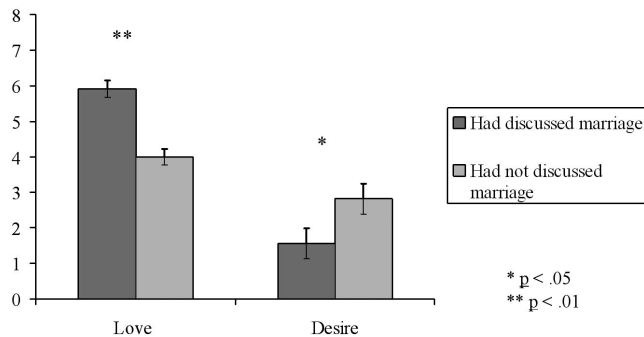


Figure 1. Adjusted mean levels of love and desire for couples who had and had not discussed marriage

Self-reports of desire, conversely, were negatively related to commitment, $r(60) = -.30, p < .05, r^2 = .09$. Moreover, as Figure 1 shows, couples who had discussed marriage reported feeling less desire than couples who had not discussed marriage, after we controlled for love, $F(1, 60) = 6.48, p < .05, \eta^2 = .10$. Desire, after we controlled for love, was positively and significantly related to sexual satisfaction, $r(52) = .34, p < .05, r^2 = .12$; greater use of sex to influence the partner, $r(60) = .32, p < .05, r^2 = .10$; perception of the partner as using more sex for relationship influence, $r(60) = .29, p < .05, r^2 = .08$; and perception of the partner's tease as motivated to express sexual attraction, $r(60) = .28, p < .05, r^2 = .08$.¹ Finally, as Figure 2 shows, couples who reported they were engaging in sexual intercourse reported more desire than couples who were not engaging in sexual intercourse, after we controlled for love, $F(1, 56) = 4.35, p < .05, \eta^2 = .07$.²

Controlling for length of relationship in the analyses presented in Figures 1 and 2 did not alter the results. The correlation between desire and using sex to influence the relationship was larger than the correlation between love and using sex to influence the relationship, self-report, $t(64) = 2.52, p < .05$; partner estimate, $t(64) = 2.42, p < .05$.

¹ Because the item "We are in love" included the term *love*, we retested our findings on the commitment scale excluding this item and found the same pattern and significance of results. We also tested our finding on the sexual satisfaction scale excluding agreement about sex, which may not be as face valid an indicator of sexual satisfaction, and found the same pattern and significance of results.

² We also ran zero-order and partial correlations between each of the dependent measures in Table 4 and partner estimates of love and desire as well as displays of affiliation and sexual cues. Partner estimates of love were significantly and positively related to self-reported commitment and perceptions of the partner's tease as motivated to express closeness, even after we controlled for partner estimates of desire. Partner estimates of desire were significantly and positively related to perceiving the partner's tease as motivated to express sexual attraction before we controlled for partner estimates of love and were negatively correlated with reports of commitment after we controlled for partner estimates of love. Couple-level affiliation cue displays were close to significantly related to commitment ($p < .07$) after we controlled for sexual cue displays. Sexual cue displays were not significantly correlated with any of the outcome measures.

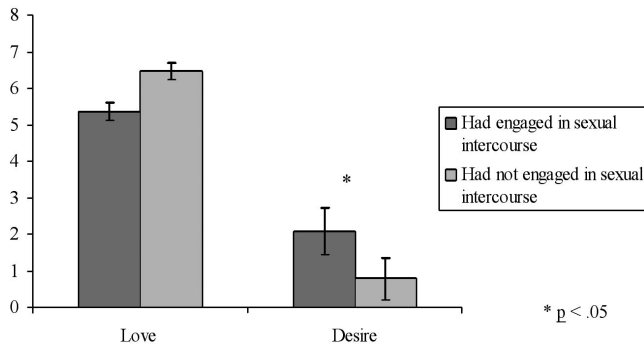


Figure 2. Adjusted mean levels of love and desire for couples who had and had not engaged in sexual intercourse.

Does Attachment Style, Ethnicity, or Relationship Length Explain the Relations Between Love and Commitment and Between Sexual Desire and Sex?

The underlying dimensions of adult attachment predict relationship satisfaction (Collins & Read, 1990; Keelan, Dion, & Dion, 1994; Simpson, 1990), love and sexual attraction (Hazan & Shaver, 1987; Mikulincer & Erev, 1991), and the emotional makeup of ongoing relationships (Feeney & Ryan, 1994; Magai, Distel, & Liker, 1995; Simpson, 1990). Various ethnic groups have different norms for the expression of emotion and judge emotional expressions differentially (Matsumoto, 1993; Matsumoto & Ekman, 1989; Tsai et al., 2002; Tsai & Levenson, 1997), and the emotional makeup of intimate relationships changes over time (R. J. Sternberg, 1986). These findings raise the following questions: Does adult attachment, couples' ethnicity, or length of the relationship explain the observed relationships between love and commitment measures and between sexual desire and sexual behavior measures? To address these possibilities, we reran three times each of our partial correlations relating our emotion measures to our commitment and sexual behavior measures. In the first set of partial correlations, we controlled for the couple's ethnicity. In the second set, we controlled for the couple's measures of attachment avoidance and attachment anxiety and the interaction term of the two dimensions. With a third set of analyses we controlled for length of the relationship. As Table 5 shows, the expected effects remained significant in 17 out of 18 cases after we controlled for the ethnicity of the couple, attachment, or length of the relationship. In the single exception, the relationship between desire and teasing to display attraction dropped to marginal significance after we controlled for length of the relationship. In sum, neither attachment, ethnicity of the couple, nor length of the relationship accounted for the association between love and desire and measures of commitment and sexual behavior.³

Discussion

In Study 1, we found that the momentary experiences of romantic love and sexual desire were distinct in their experiential correlates, expressive behavior, and relationship outcomes. In terms of experience, love and desire correlated with different emotions. Love related most strongly to happiness, an approach-related state, whereas desire was more strongly correlated with arousal and

states, such as fear and concern, that enhance attention to others. In terms of expression, self-reports of love—but not desire, happiness, or arousal—were related to affiliation cue displays (e.g., Duchenne smiles, gesticulation), whereas self-reports of desire—but not love, happiness, or arousal—were related to sexual cue displays (e.g., lip bites, touching the lips). In terms of relationship outcomes, love was correlated with a variety of measures of increased commitment. Desire but not love correlated with measures of sexual satisfaction and behavior. We observed the relationships between love and measures of commitment and between sexual desire and measures of sexual behavior across different ethnic backgrounds, attachment styles, and lengths of relationship, which suggests some degree of universality in the markers of momentary romantic love and sexual desire.

Before presenting our study of OT, we first consider three implications of the findings related to the experience and display of romantic love and sexual desire. In terms of experience, the positive correlation between self-reports of love and desire merits discussion. Our hypotheses are based on the assumption that these two states—romantic love and sexual desire—are functionally independent. The covariation that we observed in Study 1 between love and desire is not surprising in the context of a discussion about a first date, which makes issues of pair bonding and sexual behavior salient. More generally, this covariation between these two states may be evidence of how romantic love and sexual desire can regulate each other in certain contexts (for a discussion, see Diamond, 2003).

In terms of expression, it is fair to ask whether the affiliative markers of romantic love that we have focused on—the Duchenne smiles, forward leans, open gestures, and head nods—are unique to romantic love. In the context of Study 1—a discussion about a first date—this proved to be the case; these affiliative cues related to the experience of romantic love but not happiness or sexual desire. In other contexts, however, these cues

³ We also ran interactions between ethnicity and love as well as ethnicity and desire predicting each of the outcome measures shown in Table 5. Of the 36 interaction terms we ran, only 1 emerged as significant after we corrected for the number of analyses we ran. There was a significant difference between Caucasians and Asians in how strongly love predicted commitment. This interaction showed that there was a much stronger relationship between love and commitment in Caucasians than in Asians. Considering the large number of analyses that we completed and the fact that no other significant interactions emerged, the reader should interpret this result with caution.

In addition, the reader no doubt wonders about sex differences in our effects. Because the data are dyadic in nature and because nonverbal behavior often violates the assumptions needed to use structural equation modeling, we were forced to average the couple together to complete our behavior analysis. However, we did divide the sample by gender and correlate love and desire to each other, the other emotional states reported in Table 2, and the outcome measures in Table 4. We then tested the differences between men and women in these correlations. We found only two differences. Men had a stronger relationship between love and amusement ($r = .52$) than women ($r = .20$), $Z(64) = 2.06$, $p < .05$, and women had a more negative relationship between love and using sex as an influence tactic ($r = -.26$) than men ($r = .10$), $Z(64) = 2.02$, $p < .05$. It is not surprising to find few sex differences, considering that we drew our measures of love and desire from a time when the couples were interacting with each other, which likely made their responses more similar.

Table 5
Partial Correlations Between Self-Reports of Love, Desire, Commitment, and Sexual Behavior

| Self-report | | | | Love controls (partial <i>r</i>) | | | Desire controls (partial <i>r</i>) | | |
|--------------------------------------|-----------------|-----------------|---------------|-----------------------------------|--------------|---------------|-------------------------------------|--------------|---------------|
| | Ethnic <i>R</i> | Attach <i>R</i> | Length of rel | Ethnic | Attach | Length of rel | Ethnic | Attach | Length of rel |
| Relationship commitment | .19 | .59** | .26 | .59** | .50** | .58** | -.27* | -.27* | -.26* |
| Sexual satisfaction | .21 | .18 | -.07 | .10 | -.01 | .02 | .36* | .29* | .31* |
| Use of sex to influence relationship | | | | | | | | | |
| Self-reported use | .02 | .21 | -.16 | -.22† | -.24† | -.20 | .34** | .35** | .30* |
| Perception of partner use | .29† | .19 | -.11 | -.25† | -.20 | -.21 | .37** | .28* | .28* |
| Perceived partner teasing motives | | | | | | | | | |
| Express sexual attraction | .22 | .38* | -.21 | .05 | .20 | .10 | .34** | .28* | .24† |
| Emphasize closeness of relationship | .27† | .19 | -.05 | .44** | .42** | .45** | -.08 | -.13 | -.15 |

Note. Predicted effects are shown in boldface. Ethnic = ethnicity; Attach = attachment; rel = relationship.

† $p < .10$. * $p < .05$. ** $p < .01$.

may relate to other emotions. For example, the Duchenne smile relates to a variety of positive states, such as happiness (Keltner, Ekman, Gonzaga, & Beer, 2003). In previous work, we found that these four affiliation cues were related to the love felt between two friends (Gonzaga et al., 2001). Thus, it is important to ask whether our four affiliative cues might signal various kinds of love, such as the love between siblings, between parents and children, or even between strangers. This kind of work could help sharpen theoretical claims about the varieties of love. Searching for nonverbal cues that are distinct to filial and romantic love, for example, could inform discussions about whether romantic love in fact is derivative, or exapted, from filial love (Diamond, 2003; Hazan & Shaver, 1987).

Finally, it is striking that self-reports of momentary sexual desire were, after we controlled for self-reports of love, negatively related to relationship commitment. This finding poses problems for the view that sexual desire is an initiation device that helps forge initial bonds between romantic partners while intimacy grows (e.g., Hazan & Zeifman, 1999; R. J. Sternberg, 1986), an issue we take up in the General Discussion.

Study 2: The Role of OT in Romantic Love and Sexual Desire

In Study 2, we used data collected by Turner, Altemus, Enos, Cooper, and McGuinness (1999; for methods and other results, see Turner et al., 1999) to examine whether affiliative and sexual cues relate distinctly to levels of OT released into the bloodstream. OT, a mammalian hormone, is a peptide consisting of nine amino acids. It is released both in the central nervous system (CNS) and in the bloodstream and may promote bonding behavior by reducing anxiety (Carter & Altemus, 1997; Taylor et al., 2000; Uvnas-Moberg, 1998) and making social contact and affiliation pleasant (Insel, Young, & Zuoxin, 1997; Panksepp, 1998). OT is claimed to be one biological substrate of love (Carter, 1998; Insel, 1993).

Two lines of evidence indirectly point to the role OT plays in commitment and love. First, comparisons between prairie voles, which display pair bonding, and the closely related montane voles, which do not pair bond, reveal differences in the location of OT receptors in the CNS of each species (Carter, 1998; Insel et al., 1997). Moreover, injections of OT directly into specific areas of the CNS increase preferences for a single partner over other

partners in the prairie vole, whereas injections of OT antagonists depress single partner preference (Williams, Insel, Harbaugh, & Carter, 1994).

In humans, Turner et al. (1999, 2002) were the first to investigate OT response to positive emotional stimuli. In one study, women provided blood samples while reliving memories of love, while reliving memories of sadness of loss or abandonment, and during a massage from a female masseuse. Circulating OT increased in response to massage but decreased when participants recounted the loss of a loved one. Women who were in a romantic relationship had greater increases in OT while recalling a love event than women who were not in a relationship (Turner et al., 1999). In follow-up work, Turner et al. (2002) found that OT decreased while women relived an experience of happiness because of love or infatuation.⁴ Finally, it has also been found that OT is released in humans during sexual activity (Carmichael, Dixen, Palmisano, Greenleaf, & Davidson, 1987; Murphy, Seckl, Burton, Checkley, & Lightman, 1987). Some theorists posit that this OT release promotes bonding between individuals who have engaged in sexual activity (Carter, 1998; Hazan & Zeifman, 1999). These findings suggest that circulating OT levels change in response to emotional stimuli and may relate to the display of affiliation cues, to the experience of love, and perhaps to sexual cues as well. The current study is the first to document how OT relates to the expression of affiliation and sexual cues in humans.

In Study 2, we use data collected by Turner et al. (1999) to test the hypothesis that the display of affiliation and sexual cues relates to OT response. In this study, female participants completed a modified version of the Relived Emotion Task (RET; Levenson, Ekman, & Friesen, 1990; Turner et al., 1999, 2002). The RET uses participants' own past experience to elicit emotion and has been associated with physiological and self-reported changes in emotional experience (e.g., Levenson et al., 1990; Turner et al., 1999).

⁴ One might think that this result contradicts the other findings reported on the link between love and OT. However, for a number of reasons, it is unclear what absolute increases or decreases in OT mean. First, in this specific study, Turner et al. (1999) induced happiness about feeling love rather than love directly. Second, release of OT into the bloodstream may not reflect how OT functions in the CNS. This study does show that the OT system responds to emotion inductions related to the experience of love.

We expect the display of affiliation cues but not the display of sexual cues to relate to self-reports of love. On the basis of theorized links among OT, love, and monogamy (e.g., Carter, 1998), we expect the display of affiliation cues to relate to changes in blood plasma levels of OT. We also explore the relationship between OT release and the display of sexual cues, because OT is released during sexual activity (Carmichael et al., 1987; Murphy et al., 1987).

Method

Participants

Twenty-six nulliparous women between the ages of 23 and 35 years ($M = 28.12$, $SD = 4.0$) were recruited by advertisement for paid participation in a study of emotion. Participants were of varying ethnicity (17 Caucasian, 5 Asian, 2 Latina, and 1 African American). One participant was dropped because of difficulties obtaining blood samples. All procedures and consent forms were approved by the institutional review board at the University of California, San Francisco, and the California School of Professional Psychology.

Procedure

The procedure began at 8:30 a.m. and lasted approximately 3 hrs. The interviewer explained the procedure and obtained the participants' written consent. Participants sat in a comfortable chair in a private room during the procedure while a nurse, who was screened from the participant by a curtain, drew blood from an indwelling intravenous catheter.

Participants completed three tasks in counterbalanced order. A female massage therapist provided a 15-min soft Swedish massage of the neck and shoulders. The participants completed two emotion induction procedures using RET instructions (Levenson et al., 1990). Participants were asked to recall two target emotions: (a) a positive emotional experience regarding love or infatuation (love condition) and (b) a negative or sad experience regarding loss or abandonment (sadness condition). Because of our interest in love and sexual desire, we excluded the loss condition and the massage condition from analysis. Turner et al. (1999) reported results relevant to these two conditions.

In the first part of the RET, participants were asked to *recount* to the experimenter an event in which they felt the target emotion (either love/infatuation or sadness). During the second part of the procedure, participants were asked to *relive* the emotion felt during the event and indicate when they began to feel the target emotion by pressing a lever that signaled the experimenter. After each trial, participants rated how intensely they felt the emotion (love or sadness) on a scale from 0 = *not at all* to 8 = *extremely*. Participants also identified any other emotions they experienced during the task and rated their intensity on the same scale.

Eleven blood draws were taken during the procedure. After a habituation period of 45 min, two baseline draws were taken 15 min apart. The task-related draws (two for each condition) were taken (a) when the participants indicated they were experiencing the positive emotion, (b) 5 min after the positive emotion, (c) when the participant indicated they were experiencing the negative emotion, (d) 5 min after the negative emotion, (e) during the massage, and (f) 5 min postmassage. Three interim baselines were taken: (a) 30 min after the positive emotion, (b) 30 min after the negative emotion, and (c) 30 min postmassage.

The half-life of OT is only a few minutes (Amico, Ulbrecht, & Robinson, 1987). By spacing the love RET, the sadness RET, and the massage 30 min apart from each other, Turner et al. (1999) allowed OT levels to return to baseline between parts of the procedure. Once taken, blood samples were immediately placed in chilled EDTA tubes and were centrifuged at 3,000 g at 4 °C within 1 hr. Plasma samples were stored at -20 °C until assay. OT levels in plasma were determined via previously validated

extraction and radioimmunoassay techniques (Demitrack et al., 1990; Weitzman, Glatz, & Fisher, 1978), and there was a threefold concentration of OT during the extraction. Sensitivity of the OT assay was 2.1 pg/ μ l, and the IC₅₀ was 30.8 pg/ μ l. The intra-assay coefficient of variation was 12% (for another review of the methods, see Turner et al., 1999). We measured OT change using OT reactivity (peak OT - final baseline OT), which measures the departure of OT from baseline to the experience of love. We used the final baseline measure of OT because it was collected the longest after the original insertion of the catheter and was not confounded with the massage or loss conditions.

Coding of Behaviors

Each participant was videotaped during her RET with a VHS video camera mounted on a tripod approximately 5 ft (1.52 m) away from and directly in front of the participant. The video captured the participants from the upper torso to the top of the head. To gain a measure of the momentary expression of love, seven trained judges who were blind to the hypotheses of the study coded the occurrence of affiliation and sexual cues during the recount portion of the RET for each participant. We coded the recount part of the RET because initial review of the videotapes revealed that participants displayed little expressive behavior during the relive part of the RET. Because the relived portion of the RET occurred immediately after the recount part, changes in OT levels should reflect the recount and the relive portions of the RET.

Each judge coded the frequency and duration of the affiliation and sexual cues for 2 to 4 participants. Duration times were taken, in seconds, from when the behavior was first apparent until the time the behavior ceased to be displayed, according to a time code generator on the VCR. To establish reliability, two of the judges coded the same six cases (22% of the total sample). An agreement was recorded if (a) both judges coded the same affiliation or sexual cue during the same second or (b) neither judge coded an affiliation or sexual cue during a given second. A disagreement was recorded if only one judge coded the occurrence of an affiliation or sexual cue during a second. Judges agreed 95.5% of the time ($\kappa = .87$).

Results

Overview

To control for differences in time of recounting, we divided the durations of affiliation and sexual cues, measured in seconds, by the amount of time it took the participant to recall the event. We averaged standardized values of the four affiliation cues and six sexual cues to create overall affiliation cue and sexual cue display scores, respectively.

Displays of Affiliation and Sexual Cues During the RET

Participants took an average of 126 s to recount their experience. Every participant displayed at least one affiliation cue, with slightly fewer than 85% of the participants displaying Duchenne smiles or affirmative head nods. The average duration of affiliation cue display was 11.61 s/min. A majority (61.5%) of the participants displayed at least one sexual cue, with slightly fewer than 40% of the participants displaying lip licks. The average duration of sexual cue displays was 1.03 s/min for participants who displayed at least one sexual cue. Women self-reported an average score of 5.1 ($SD = 1.51$) regarding how much love they experienced during the RET.

Do Affiliation Cues Relate to Self-Reports of Love?

To test whether love was encoded as affiliation cues, we ran a partial correlation between participants' affiliation cue displays

and their self-reports of love, controlling for participants' display of sexual cues (a proxy for sexual desire). We found a close to significant positive partial correlation, $r(22) = .38, p < .07, r^2 = .144$, as expected. The partial correlation relating participants' sexual cue display with self-reports of love, with controls for participants' display of affiliation cues, was not significant, $r(22) = .26$.

Does the Display of Affiliation Cues Relate to the Release of OT?

We expected affiliation cues to positively correlate with OT reactivity during the RET. To test this prediction, we ran a partial correlation relating participants' display of affiliation cues to their OT reactivity scores and controlling for participants' display of sexual cues. As Table 6 shows, we found a significant positive partial correlation between OT reactivity and participants' affiliation cue displays, $r(24) = .50, p < .05, r^2 = .25$. The partial correlations between participants' sexual cue display score and their OT reactivity score, with controls for participants' display of affiliation cues, was not significant. The difference between these two correlations was not significant. In contrast to the display findings, participants' self-reports of love did not correlate with OT reactivity.⁵

Discussion

The results of Study 2 replicate the link between affiliation cues and love found in Study 1. Affiliation cues but not sexual cues related to self-reports of love. Moreover, OT reactivity was positively related to the display of affiliation cues but not to the display of sexual cues. This is the first work to show a relationship between the display of affiliation cues and OT release. It is also among the first to explore the links between emotion and OT (see also Turner et al., 1999, 2002) and adds to a growing number of investigations on the neurochemical basis of affiliation in humans (see Knox & Uvnas-Moberg, 1998; Porges, 1998; Turner et al., 1999, 2002; Uchino, Cacioppo, & Keicolt-Glaser, 1996). There are likely to be other neurochemical markers of love, such as prolactin or endorphins, which relate to nurturing behavior (Panksepp, 1998).

The current study has obvious limitations. The sample was small. One must consider this when assessing the nonrelationship between sexual cue displays and OT reactivity, because it poses a significant Type II error risk. Moreover, we had no self-report measure of sexual desire and cannot be fully confident that suitable

levels of sexual desire were elicited. We note, however, that sexual cues were displayed during the RET at approximately the same frequency as by the couples in Study 1, and Study 1 validated the connection between sexual cues and reports of sexual desire.

Moreover, we did not investigate potential neuroendocrine markers of sexual desire. Research suggests that androgens (e.g., testosterone) and estrogen in women are involved in the experience of sexual desire (e.g., Davidson, Carmargo, & Smith, 1979; Halpern, Udry, Campbell, Suchindran, & Mason, 1994; Rabkin, Rabkin, & Wagner, 1995; Sherwin, 1988; Wallen, 2001; Young, 1987). Establishing a link between levels of circulating androgens (and estrogen in women) and the display of sexual cues would provide further evidence differentiating romantic love and sexual desire.

General Discussion

Diverse theoretical accounts converge on the notions that romantic love promotes long-term commitment and that sexual desire promotes reproductive behavior (Aron & Aron, 1991; Berscheid, 1985; Buss & Schmitt, 1993; Diamond, 2003; Gonzaga et al., 2001; Regan & Berscheid, 1999; Shaver et al., 1988). It is also widely assumed that romantic love and sexual desire serve these functions both as enduring sentiments toward romantic partners and as brief, emotion-like experiences that shape ongoing social interactions. Guided by these claims, we examined relatively brief occurrences of romantic love and sexual desire. Following social functional accounts of emotions, we proposed that romantic love and sexual desire are distinct states that serve pair-bonding and reproductive functions within ongoing intimate interactions via distinct experiential correlates, displays, and physiological markers.

Consistent with these claims, Study 1 shows that romantic partners' momentary experience of love during a brief interaction surrounding discussions of intimacy was related to emotions that promote approach (e.g., happiness), was signaled by a set of affiliation cues (affirmative head nods, Duchenne smiles, gesticulation, leaning toward the partner), and was related to markers of commitment and connection in the relationship (e.g., discussion of marriage). In contrast, the momentary experience of sexual desire was related to emotions that promote attention and arousal, was signaled by a set of sexual cues (i.e., lip licks, biting, touching, and sucking the lips, and protruding the tongue), and was related to markers of sexual behavior (e.g., reports of sexual intercourse with the partner). In Study 2, the expression of affiliation cues was positively related to OT reactivity, a neuroendocrine response thought to be associated with long-term commitment and monogamy. Recent imaging studies showing that romantic love may lead to distinct patterns of brain activation lend further credence to the

Table 6
Correlations of Affiliation and Sexual Cue Displays With Oxytocin Reactivity

| | Oxytocin reactivity | |
|------------------|------------------------|---------------------|
| | Zero-order correlation | Partial correlation |
| Affiliation cues | .51* | .50* |
| Sexual cues | -.04 | .11 |

Note. Oxytocin reactivity = peak oxytocin minus initial baseline.
* $p < .05$.

⁵ We also coded the content narratives to see whether women were recounting experiences that fitted our definitions of love and sexual desire. Two cases did not clearly fit into either experience. When we excluded them from analysis, the magnitude and significance of our results did not change. Of the remaining 24 cases, 18 were judged to be more like a love experience, and 6 were judged to be more like a sexual desire experience. When we controlled for this distinction, our results did not change in magnitude or significance.

claim that romantic love and sexual desire are distinct processes (Aron et al., 2004; Bartles & Zeki, 2000).

The limitations to the current work are numerous and highlight the need and the promise for further research. In Study 1, our sample was young dating couples. Whether older couples show similar displays associated with reports of romantic love and sexual desire is significant for purposes of generalizability. This kind of study also raises interesting and unanswered questions. How do the displays of romantic love and sexual desire shift with age? Are long-term partners better able to judge each other's displays of romantic love and sexual desire than younger partners? As sexual desire presumably wanes and companionate love rises over the course of a long-term bond, do the affiliative displays of romantic love become more pronounced? We believe the methods and findings we offer in this article provide a means for answering these and other questions regarding the forms and functions of romantic love and sexual desire.

In Study 2, we did not have a self-report measure of sexual desire and used the display of sexual cues as a proxy. Moreover, we asked participants to recall a time of great love or infatuation. In critical regards, then, the experimental context and measures used in Study 2 might not have allowed for an assessment of intense sexual desire. Had we studied more intense occurrences of sexual desire, we might have seen significant associations between the sexual cues and oxytocin release. This possibility awaits empirical attention and is facilitated by the findings we have generated documenting the nonverbal display of sexual desire.

Romantic Love and Sexual Desire in Romantic Relationships

The present findings replicate and extend previous work related to the thesis that romantic love acts as a commitment device that binds romantic partners together in long-term relations (e.g., Frank, 1988; Gonzaga et al., 2001). In Study 1, self-reports of love were related to commitment-enhancing behaviors (e.g., discussions of marriage) and perceptions—a finding that was replicated across three different ethnic groups. In Study 2, the nonverbal display of affiliation cues was related to the release of OT, a neuropeptide associated with monogamous, committed behavior in nonhuman animals (e.g., Carter, 1998). Our findings dovetail with other studies illustrating the benefits of self-sacrifice and devotion in long-term romantic bonds (e.g., Van Lange et al., 1997). The evidence from the present two studies suggests that these commitment-related processes occur within very brief interactions and may have a neuroendocrine basis.

Whereas our findings concerning love largely complement and extend what is known, the findings related to sexual desire challenge a basic assumption about this experience. Many researchers have assumed that sexual desire serves an initiation function by motivating proximity seeking, which in turn keeps partners together during the early stages of a relationship while commitment grows (e.g., Hazan & Zeifman, 1994, 1999; Zeifman & Hazan, 1997). Our evidence shows that sexual desire was at the least unrelated to commitment and that after we controlled for love it was negatively related to commitment. This suggests that sexual desire, in the absence of love, may play a larger role in motivating the pursuit of short-term mating strategies rather than initiating long-term commitments (e.g., Buss & Schmitt, 1993). If so, one

would expect the brief episodes of sexual desire to predict other outcomes that are antithetical to long-term commitment, including pursuing other mating opportunities, exiting relationships, and taking actions that undermine long-term commitment. These intriguing ideas await empirical attention.

Of course, the relationship among sexual desire, arousal, hormones, and behavior is complex. Our definition of sexual desire emphasizes how it motivates sexual behavior. However, sexual behavior can occur for multiple reasons; one can initiate sex or be receptive to the sexual advances of a partner. Sexual behavior may not occur in the presence of desire—for example, one might feel sexual desire toward an attractive stranger but not want to endanger an ongoing relationship. Female sexuality is likely more flexible than male sexuality and can be elicited by a greater set of stimuli, not all of which are desired (Baumeister, 2000; Chivers, Rieger, Latty, & Bailey, 2004; Wallen, 2001). Finally, sexual desire and measures of physiological arousal are not always highly correlated (e.g., Both, Spiering, Everaerd, & Laan, 2004; Laan, Everaerd, van der Velde, & Geer, 1995). Thus, the relationship among sexual desire, hormones, behavior, and physiological arousal is quite complex and warrants continued empirical attention.

Biological Markers of Emotion

Our results also have implications for understanding the link between biology and emotion. Although theorists have promoted the idea the OT is a biological underpinning of love (e.g., Carter, 1998), there have been few empirical tests of this hypothesis in humans. Although our findings are consistent with this claim, they also reveal the complexity of the relationship between neuroendocrine response and emotional experience.

In this study, OT reactivity was related to behavioral displays of love but not self-reports of love. Although it is possible that we did not have sufficient power to uncover a relationship between OT and self-reports of love, there are other explanations. One intriguing possibility, consistent with our data, is that OT may relate to the desire to affiliate (e.g., Taylor et al., 2005). Social functional accounts of emotion posit that one of the roles of the expressive signal of emotion is to elicit desired behavior from social partners. In Study 2, participants were feeling love for an absent partner and might have wanted to be close to that person. If OT does promote the desire to affiliate, it would explain why OT reactivity was related to the expressive display of love but not the self-report of love, at least under these circumstances. These results highlight the potential rewards and hazards of studying neuroendocrine response and emotional experience. An understanding of these links may uncover new and potentially valuable insights about the biology of commitment. However, the relationship between emotional experience and biology is undoubtedly complex, and it will take time to fully elucidate these pathways.

Are Romantic Love and Sexual Desire Emotions?

When researchers ask participants to list states they consider emotions, love is typically near the top of that list (Fehr & Russell, 1984, 1991). Sexual desire and synonyms, such as lust and sexual arousal, also commonly appear in lay individuals' lists of emotion. As Table 7 shows, many emotion researchers, in contrast, tend not

Table 7
The Representation of Love and Desire Among Emotion Theorists

| Buck (1999) | Ekman (1992) | Fehr and Russell (1984) ^a | Izard (1977) | Lazarus (1991) | Oatley & Johnson-Laird (1987) | Panksepp (1998) | Roseman, Spindel, and Jose (1990) | Shaver et al. (1987) | Smith and Ellsworth (1985) | Tomkins (1984) |
|-------------|----------------------------|--------------------------------------|--------------|----------------|-------------------------------|-----------------|-----------------------------------|----------------------|----------------------------|----------------|
| Anger | Anger | Anger | Anger | Anger | Anger | Expectancy | Anger | Anger | Anger | Anger |
| Anxiety | Awe ^b | Anxiety | Contempt | Anxiety | Disgust | Fear | Contempt | Fear | Boredom | Contempt |
| Boredom | Contempt | Awe | Disgust | Compassion | Fear | Joy | Disgust | Joy | Challenge | Disgust |
| Curiosity | Disgust | Boredom | Fear | Disgust | Happiness | Love | Dislike | Love | Contempt | Distress |
| Disgust | Embarrassment ^b | Calmness | Guilt | Envy | Sadness | Lust | Distress | Sadness | Disgust | Enjoyment |
| Distress | Excitement ^b | Depression | Happiness | Fear | | Pain | Fear | Surprise | Fear | Fear |
| Envy | Fear | Disgust | Interest | Guilt | | Pleasure | Frustration | | Frustration | Interest |
| Expectancy | Guilt ^b | Embarrassment | Pain | Happiness | | Rage | Guilt | | Guilt | Shame |
| Fear | Happiness | Envy | Sadness | Hope | | Sorrow | Hope | | Happiness | Surprise |
| Guilt | Interest ^b | Excitement | Shame | Jealousy | | | Joy | | Hope | |
| Happiness | Sadness | Fear | Surprise | Love | | | Love | | Interest | |
| Interest | Shame ^b | Guilt | | Pride | | | Pride | | Pride | |
| Jealousy | Surprise | Happiness | | Relief | | | Regret | | Sadness | |
| Love | | Hate | | Sadness | | | Relief | | Shame | |
| Lust | | Joy | | Shame | | | Sadness | | Surprise | |
| Panic | | Love | | | | | Shame | | | |
| Pity | | Pride | | | | | Surprise | | | |
| Pride | | Sadness | | | | | | | | |
| Sadness | | Worry | | | | | | | | |
| Scorn | | | | | | | | | | |
| Shame | | | | | | | | | | |
| Surprise | | | | | | | | | | |

Note. Boldface stands for an emotional state that represents either love or desire.
^a Fehr and Russell (1984) proposed these as prototypical concepts of emotions, not as actual emotions. ^b Ekman has only recently acknowledged that these may be distinct emotions.

to treat romantic love and sexual desire as distinct emotions (Ekman, 1992; Izard, 1977; Oatley & Johnson-Laird, 1987; Tomkins, 1984). Instead, they claim that romantic love and sexual desire lack hallmark features of emotion, such as distinct phenomenological qualities or expressive behavior, and have different temporal dynamics.

This is starting to change. Both Fredrickson (1998) and Shaver (see Hazan & Shaver, 1987; Shaver et al., 1988; Shaver, Morgan, & Wu, 1996) have argued that love is an emotion with distinct evolutionary roots (see also Buck, 1999). In a recent theoretical account, Diamond (2003) detailed that love and sexual desire are functionally independent systems with different biological bases and proximal goals, criteria often used to define emotion (Ekman, 1992). The current investigation suggests that love and sexual desire have distinct experiences, expressions, appraisals, and biological underpinnings—criteria used by emotion theorists to define and differentiate emotion (e.g., Ekman, 1999). Moreover, our evidence that love and sexual desire are related to distinct behaviors and relationship outcomes is consistent with recent claims that the function of positive emotions is to regulate interpersonal bonds (Keltner & Haidt, 1999). Our evidence, of course, does not conclusively demonstrate that romantic love and sexual desire are emotions. For example, we did not show that the expressive display of romantic love and sexual desire are universal or that these states have distinct appraisals, both important criteria used to define emotion (Ekman, 1992).

Despite these limitations, we believe that considering romantic love and sexual desire as emotions offers fruitful lines of inquiry. Our studies on expressive behavior point to new means of studying

cultural variation and universality in romantic love and sexual desire (Abu-Lughod, 1986; Eibl-Eibesfeldt, 1989; Hatfield & Rapson, 2002; Jankowiak, 1995; Jankowiak & Fischer, 1998). Our findings concerning the expressive signals of romantic love and sexual desire can be useful in studies of relationships, given that emotions have proven important for long-term relational satisfaction (e.g., Gottman & Levenson, 1986). Moreover, our findings might provide new insight and constraints regarding emerging theories of positive emotion. It is widely assumed that positive emotions are associated with more flexible, associative thought and broadening social resources (Fredrickson, 1998). Romantic love and sexual desire, conversely, seem to narrow attention and behavior to focus on a current romantic partner or attractive sexual interest and may cause the individual to sacrifice other social pursuits. These and other questions await empirical attention.

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Received December 9, 2004

Revision received September 16, 2005

Accepted October 12, 2005 ■