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Pers Soc Psychol Bull 2008; 34; 1057 originally published online May 23, 2008;
DOI: 10.1177/0146167208318141

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When Sex Primes Love: Subliminal Sexual Priming Motivates Relationship Goal Pursuit

Omri Gillath

University of Kansas

Mario Mikulincer

Gurit E. Birnbaum

Interdisciplinary Center (IDC) Herzliya

Phillip R. Shaver

University of California, Davis

The studies reported here provide, for the first time, experimental evidence to support the claim that sexual interest and arousal are associated with motives to form and maintain a close relationship. In five studies, sex-related representations were cognitively primed, either subliminally or supraliminally, by exposing participants to erotic words or pictures as compared with neutral words or pictures. The effects of “sexual priming” on the tendencies to initiate and maintain a close relationship were assessed using various cognitive-behavioral and self-report measures. Supporting the hypotheses, subliminal but not supraliminal exposure to sexual primes increased (a) willingness to self-disclose, (b) accessibility of intimacy-related thoughts, (c) willingness to sacrifice for one’s partner, and (d) preference for using positive conflict-resolution strategies. The article discusses implications of these findings for the role of sex in close relationships and offers a conceptualization of possible relational motives of the sexual behavioral system.

Keywords: *sex; close relationships; subliminal; priming; motivation*

Sexual behavior is thought to activate and, over time, to condition the physiological systems associated with pair-bonding and attachment in adulthood (e.g., Carter et al., 2005; Hazan & Zeifman, 1994, 1999). According to Hazan and Zeifman (1994, 1999), sex serves both as a motivator for two people to connect (form a close relationship) and the initial “glue” that holds them together long enough for the attachment system, love, or pair-bonding to take over and sustain the motivation to stay

together. Animal studies have provided robust evidence for the idea that sex acts as a strong motivator and reinforcer through the activation of endogenous physiological reward systems in the brain (e.g., Szechtman, Hershkowitz, & Simantov, 1981). Across time, repeated exposure to the gratifying quality of sex in association with one’s partner is thought to strengthen the desire to be with that specific partner and have more sex with him or her.

Similar findings in studies of humans suggest that certain behaviors such as foreplay (kissing, hugging, caressing), sexual intercourse, and sexual orgasm tend to result in the secretion of oxytocin and various opioids into the blood stream (e.g., Carmichael et al., 1987; Filippi et al., 2003). The increased concentration of oxytocin and opioids, in humans as in other animals, leads to positive feelings, which encourage humans to engage in further sexual activity. In the long run, the resulting positive feelings become associated with a particular partner and relationship, conditioning people to stay with that partner (e.g., Young & Wang, 2004).

When discussing the mechanisms that link sexual intercourse and pair-bonding, Carter et al. (2005) suggested that the secretion of oxytocin during sexual foreplay and

Authors’ Note: Preparation of this article was facilitated by a grant from the Israel Foundation Trustees. The authors would like to thank Yifat Golan for her help with collecting the data. Correspondence concerning this article should be addressed to Omri Gillath, Department of Psychology, University of Kansas, Lawrence, KS 66045-7556; e-mail: ogillath@ku.edu.

PSPB, Vol. 34 No. 8, August 2008 1057-1069

DOI: 10.1177/0146167208318141

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intercourse contributes not only to rewarding sensations and emotions but also to the activation of neural processes mediating social bonding and attachment (see also Nelson & Panksepp, 1998). Carter et al.'s reasoning is supported mainly by animal studies in which increases in the level of oxytocin (either artificially induced or naturally occurring) were found to affect the formation of relationships, increasing the tendency to copulate with the same partner (monogamous behavior) rather than being promiscuous. Moreover, increased oxytocin was found to enhance animals' tendency to care for close others and engage in intimate behaviors (e.g., cuddling, nuzzling) with them (Carter et al., 2005).

Young and Wang (2004) suggested that specific aspects of human sexuality are "designed" to increase the release of oxytocin and opioids into the blood stream, causing partners to become more attached to each other. Because women are "hidden ovulators" who engage in sexual activity throughout the ovarian cycle, they experience the effects of oxytocin and opioids more often than they would if these were released only during ovulation, which increases the tendency to become emotionally bonded to a particular sexual partner. Furthermore, in contrast to other mammalian females, human females have enlarged mammary tissues independent of lactation, which seem to encourage breast and nipple stimulation during sexual activities, and nipple stimulation in turn increases even more the secretion of oxytocin.

Together these findings support the idea that sexual stimuli and sexual behavior may be part of a system that contributes to relationship formation and maintenance. This suggests the possibility that exposing people to sexual stimuli will motivate them, implicitly or explicitly, to initiate and maintain a close relationship. To our knowledge, this line of reasoning has never been tested empirically. There is, of course, a large and multifaceted literature on human sexuality (reviewed, e.g., by Harvey, Wenzel, & Sprecher, 2004), but little of this research deals with the possible association between sexuality and relationship-related motives (e.g., Davis, Shaver, & Vernon, 2004; Impett, Peplau, & Gable, 2005; Schmitt et al., 2003). The existing research focuses on motives for having sex. For example, Meston and Buss (2007) recently provided an extensive review of the reasons for having sex, which resulted in a list of 237 reasons, but the authors mentioned that despite the importance of motivation to a full account of sexuality and sexual behavior, relatively little research has been done on the topic. Especially relevant to the present studies, even less research has examined the motives activated by sex, sexual attraction, or sexual arousal—other than the motivation to have sex per se.

Prior research on the motives aroused by sex has focused primarily on the role of sexuality in different stages of relationship development (e.g., Harvey et al., 2004). For

example, as would be expected based on the literature reviewed here, sexual attraction is a major motivator to form relationships (Bleske-Rechek & Buss, 2001), and sexual motives or strategies affect the kinds of relationships people form (e.g., short term vs. long term; Buss, 1989). The effects of sex and sexual attraction have been found to extend into later stages of a relationship, affecting maintenance through people's assessments of their relationship quality (e.g., Feingold, 1990; Huston & Levinger, 1978). Similarly, sexual satisfaction is positively correlated with relationship commitment and overall relationship satisfaction and stability (e.g., Breznsnyak & Whisman, 2004; Sprecher & Cate, 2004). On the other hand, lack of sexual interest in one's partner and sexual infidelity on either partner's part are associated with lower relationship stability and earlier relationship dissolution (e.g., Judith & Deirdre, 2000).

Recently, Birnbaum and Gillath (2006) reported further evidence for the suggested links between sex and relationship-related motives, showing that people tend to say they have sex as a means of initiating and maintaining romantic relationships. Together, the existing studies suggest that sex and sexual behavior are indeed associated with motivation to form and maintain close relationships, but they do not provide evidence for the causal direction of the association. That is, they do not show that sexual stimulation motivates people to initiate and maintain close relationships.

In a search for such evidence, we conducted the five experiments described in this article. In these experiments we exposed people to sexual (or neutral) stimuli and examined whether this exposure increased their tendency to initiate and maintain a close relationship. This increase was predicted to manifest itself in greater willingness to self-disclose, to sacrifice for a partner's benefit, and to choose prorelational conflict-resolution strategies; it was also expected to increase the accessibility of intimacy-related thoughts.

Previous studies using exposure to sexual stimuli, such as erotic pictures (e.g., pictures of opposite-sex nudes presented to heterosexual individuals), erotic stories, or erotic films, resulted in greater sexual arousal and greater cognitive readiness to use sex-related mental content in information-processing tasks. For example, Laan and Everaerd (1995) found that exposure to erotic slides, as compared with neutral slides, increased self-reports of sexual arousal and affected objective measures of genital responses (see also Dekker & Everaerd, 1988). Spiering, Everaerd, and Janssen (2003) found that subliminal but not supraliminal priming with erotic pictures decreased latencies for identifying sexual (as compared with nonsexual) stimuli, indicating that a subliminal sexual prime can automatically heighten the accessibility of sex-related material in memory. Conversely, exposure to supraliminal sexual primes heightened self-reports of sexual arousal while slowing down the identification of

other sex-related stimuli, possibly because of socially or morally instigated suppression tendencies.

Similarly, in a recent study, Gillath, Mikulincer, Birnbaum, and Shaver (2007) found that a subliminal sexual prime (a picture of a naked person of the opposite sex) increased the mental accessibility of sexual words and sexual images, as compared with the effects of a neutral prime. In a different study, Gillath, Bunge, and Shaver (2006) used functional magnetic resonance imaging (fMRI) to examine people's neural processes while they were subliminally or supraliminally exposed to erotic pictures. With both kinds of stimulus presentation (subliminal and supraliminal), sexual primes (naked people), as compared with either positive nonsexual, human nonsexual (dressed people), or neutral primes, increased activation in sex-related regions of the brain (e.g., the thalamus and Brodmann's area 7, which had previously been found to be associated with sexual stimulation, orgasm, and ejaculation). However, only supraliminal exposure resulted in activation of executive control-related brain regions, such as the orbital frontal cortex. This finding, like Spiering et al.'s (2003) findings, suggests that supraliminal exposure to sexual stimuli may generate mixed or conflicted responses, resulting in a weaker overall effect compared with subliminal exposure to such stimuli. These results argue for using subliminal rather than supraliminal exposure to sexual stimuli if the goal is to see the effects of sexual responses on other motive systems.

Based on these studies, we hypothesized that subliminal priming with sexual primes, as compared with neutral primes and supraliminal sexual primes, would more strongly activate prorelationship cognitions and behavioral tendencies. Specifically, this priming should increase a person's willingness to (a) initiate a relationship—that is, get closer to and self-disclose more to a potential mate—and (b) engage in activities that increase the likelihood of maintaining an existing romantic relationship, such as sacrificing for one's partner and using positive rather than negative conflict-resolution strategies. This should especially be the case among people who are already in a close relationship because they have something concrete and real to maintain. Moreover, subliminal sexual priming is expected to increase the mental accessibility of concepts related to initiation and maintenance of close relationships, such as thoughts of emotional closeness and intimacy with a romantic partner.

STUDY 1

In Study 1, we examined the effects of exposure to sexual stimuli on participants' willingness to self-disclose to a potential romantic partner. We interpreted

such willingness as a sign of interest in initiating a close relationship, because self-disclosure (Derlega & Grzelak, 1979) is known to be important to relationship initiation (e.g., Sprecher & Hendrick, 2004; for a review, see Dindia, 2002). If activation of the sexual system results in motivation to initiate a relationship, exposure to a sexual stimulus should increase willingness to self-disclose (Hypothesis 1).

Beyond testing the hypothesis that exposure to sexual stimuli would increase willingness to self-disclose, we also wanted to determine whether the kind of exposure (subliminal vs. supraliminal) to a sexual stimulus (viewed as a sexual prime) would affect willingness to self-disclose. Previous studies have found that supraliminal sexual priming sometimes induces negative emotional and behavioral reactions, such as disgust (LaTour & Henthorne, 1994; Tucker & Newman, 1981), which might reduce willingness to self-disclose. In contrast, subliminal sexual stimulation may bypass the conscious evaluation of sexual stimuli (Gillath et al., 2007; Janssen, Everaerd, Spiering, & Janssen, 2000) and thereby increase self-disclosure tendencies more directly with less ambivalence (Hypothesis 2).

In Study 1 we also considered the potential role of gender as a moderator of the effects of sexual priming on willingness to self-disclose. Previous studies have found that women are generally more willing than men to self-disclose (e.g., Dindia, 2002). However, Spiering, Everaerd, Karsdorp, Both, and Brauer (2006) found that women had weaker reactions than men to subliminal sexual primes, although Gillath et al. (2007) observed similar reactions in men and women to a subliminal but not to a supraliminal sexual prime. Because of these complex, inconsistent previous findings, we included roughly equal numbers of men and women in Study 1 so that we could explore possible gender differences in the effects of subliminal and supraliminal sexual primes on willingness to self-disclose.

The study was based on a 2 (prime type: sexual vs. neutral) \times 2 (level of awareness: subliminal vs. supraliminal) \times 2 (gender: male vs. female) between-subjects design and included two parts: the priming procedure and the measurement of willingness to self-disclose.

Method

Participants. One hundred eighty-one self-reported heterosexual students from Bar-Ilan University in Israel, 82 women and 99 men, aged 18-40 ($Mdn = 24$), participated for either a monetary reward or course credit. The aim of the experiment was explained beforehand, and only those who were willing to be exposed to sex-related pictures or words participated (no one declined to participate). ANOVAs and chi-square tests revealed

no significant gender differences on the demographic variables.

Measures and procedure. Participants were invited to participate individually in an experiment involving decision making, during which they would be asked to make judgments regarding neutral objects, themselves, and their social relationships. At the laboratory, participants were told they would perform some computerized tasks and fill out paper-and-pencil questionnaires. They were also informed that some of the tasks and questionnaires might involve exposure to sexual stimuli (among other types of stimuli).

In the first part of the procedure, participants were asked to rate, for 20 pairs of pieces of furniture (e.g., table and chair), how similar or associated the two were. Before seeing each pair of named objects, participants were exposed to either a sexual or a neutral prime, which was presented either subliminally (for 30 ms) or supraliminally (for 500 ms). In both cases, presentation of the prime was followed by a mask presented for 500 ms (a visual “noise” pattern that erased the prime’s image on the retina) and then by the pair of furniture names, separated by a hyphen (e.g., cabinet-chair). Based on random assignment to one of the four experimental conditions, one fourth of the participants ($n = 43$; 22 men, 21 women) were exposed to a supraliminal sexual prime, one fourth ($n = 51$; 31 men, 20 women) to a supraliminal neutral prime, one fourth ($n = 47$; 26 men, 21 women) to a subliminal sexual prime; and one fourth ($n = 40$; 20 men, 20 women) to a subliminal neutral prime. Both the sexual and the neutral primes were chosen in a set of pretests. The sexual primes were erotic but not pornographic pictures (an attractive naked, reclining man shown from the groin up for the female participants; an attractive, naked, kneeling woman photographed from behind for the male participants), and the neutral primes were abstract pictures (for further details, see Gillath et al., 2006).¹

Participants received the following instructions:

On each trial of the next task, you will see on the screen the names of two pieces of furniture (e.g., table-television). Your task will be to decide how similar or associated the two are (using any sense of “similar” or “associated” that comes to mind when you see the pair of words). You should indicate your response by pressing a number between 1 and 7 on the keyboard number pad, with 1 indicating that the two pieces of furniture are not similar or associated at all, and 7 indicating that they are highly similar or associated. (The numbers in between, 2 through 6, indicate degrees of similarity or association.) Each trial will begin with an X in the center of the screen, followed by a brief flash, and then a pair of furniture words. As soon as you press a

number key to indicate your similarity/association judgment, the next trial will begin.

The “brief flash” was actually the subliminal prime.

The task was programmed using SuperLab Pro 2.0, based on a similar procedure used in previous studies (e.g., Gillath et al., 2007), and run on an IBM PC Pentium III computer with an SVGA color monitor. Brightness and contrast were set low and the primes as well as the pairs of furniture words were displayed in shades of gray over a white background in the center of the screen.

In the second part of the procedure, immediately after the priming trials, participants completed the first 5 items of the Self-Disclosure Index (SDI; Miller, Berg, & Archer, 1983), a frequently used measure of willingness to self-disclose. (We used only 5 of the usual 10 items because we were unsure how long the subliminal priming effects would last. Even with just 5 items, the alpha reliability coefficient was acceptable, .78.) Participants were asked to rate the degree to which each of the items characterized how they would interact with a potential romantic partner on a scale ranging from 1 (*not at all characteristic*) to 6 (*extremely characteristic*). In Study 1, the scale was assumed to measure the level of intimacy a person wishes to establish with a target person.

At the end of the study, participants provided information about their relationship status, sexual orientation, and demographic characteristics. Participants were then debriefed, and if they had been in one of the subliminal priming conditions, they were asked whether they saw the prime (no one reported having seen it).

Results and Discussion

ANOVA and chi-square tests revealed no significant demographic differences between participants in the four experimental conditions. For each person, answers on the five SDI items were averaged, yielding scores that could range from 1 to 6. To test our hypotheses we conducted a three-way ANOVA on the mean SDI scores as a function of prime type (sexual vs. neutral), level of awareness (subliminal prime vs. supraliminal prime), and gender (male vs. female). The relevant means and standard deviations are presented in Table 1.

The ANOVA revealed no main effects for prime type, $F < 1$, or level of awareness, $F < 1$. However, as predicted, the interaction between prime type and awareness of the prime was statistically significant $F(1, 173) = 5.93$, $p < .05$, $\eta^2 = .04$. Simple main effects tests examining the significant interaction revealed that subliminal exposure to a sexual prime led to greater willingness to self-disclose ($M = 5.02$) than subliminal exposure to a neutral prime ($M = 4.79$), $F(1, 173) = 2.03$, $p = .05$. When exposure to the prime was supraliminal, however,

TABLE 1: Self-Disclosure Inventory Means and Standard Deviations as a Function of Prime Type, Awareness of Prime, and Gender (Study 1)

| | Sexual Prime | | Neutral Prime | |
|--------------|--------------|------|---------------|------|
| | Women | Men | Women | Men |
| Subliminal | | | | |
| M | 5.28 | 4.80 | 4.64 | 4.79 |
| SD | 0.74 | 0.81 | 0.87 | 0.67 |
| Supraliminal | | | | |
| M | 4.80 | 4.78 | 4.84 | 5.20 |
| SD | 0.70 | 0.64 | 0.74 | 0.79 |

NOTE: The rating scale used in this study ranged from 1 to 7, and all seven values were used by at least some participants.

the sexual prime reduced willingness to self-disclose ($M = 4.72$) compared with exposure to a neutral prime ($M = 4.98$), $F(1, 173) = 2.74$, $p < .05$, $\eta^2 = .03$. These findings supported our hypotheses (Hypothesis 1, that a sexual prime would increase willingness to self-disclose, and Hypothesis 2, that only subliminal but not supraliminal exposure to a sexual prime would heighten this willingness).

The ANOVA also revealed a significant interaction between prime type (sexual vs. neutral) and gender (male vs. female), $F(1, 173) = 5.13$, $p < .05$, $\eta^2 = .04$. Simple main effects tests examining this interaction revealed that exposure to a sexual prime (either subliminal or supraliminal) led, as expected, to greater willingness to self-disclose among women ($M = 5.04$, as compared with exposure to a neutral prime, $M = 4.74$), $F(1, 173) = 3.10$, $p < .05$, $\eta^2 = .03$. No such difference occurred among men. We have no interpretation of this unexpected result for men, especially given that in subsequent studies the predicted effect of subliminal sexual priming occurred for both men and women.

STUDY 2

In Study 2 we examined the possibility that sexual priming would increase people's willingness to sacrifice for their partner's benefit, an important contributor to relationship maintenance (e.g., Berscheid, 1985; Powell & Van Vugt, 2003; Van Lange et al., 1997). We define *willingness to sacrifice* as the tendency to suspend immediate self-interest to promote the well-being of one's partner or relationship. We expected subliminal sexual priming to increase willingness to self-sacrifice. Study 2 followed a 2 (prime type: sexual vs. neutral) \times 2 (awareness of the prime: supraliminal vs. subliminal) \times 2 (gender: male vs. female) between-subjects experimental design. As in Study 1, we included both supraliminal and

subliminal primes and the study included two parts: (a) a priming procedure (as in Study 1) and (b) a Hebrew version of the Willingness to Sacrifice questionnaire (Van Lange et al., 1997). We hypothesized that prime type and awareness of the prime would interact to influence willingness to sacrifice, such that only subliminal sexual priming would increase willingness to sacrifice.

Method

Participants. One hundred ninety-seven self-reported heterosexual students from Bar-Ilan University in Israel, including 98 men and 99 women, aged 19-56 ($Mdn = 31$), participated in the study. All were involved at the time in significant romantic relationships (lasting 3 months to 40 years, with a median of 78 months). Participants were recruited at a variety of locations on and off campus. The aim of the experiment was explained beforehand, and only those who were willing to be exposed to sexual pictures or words participated (no one declined). ANOVAs and chi-square tests revealed no significant gender differences in demographics.

Measures and procedure. After receiving the same kinds of instructions used in Study 1, participants completed 30 trials of the furniture-comparison task used in Study 1. During the task, participants were divided into one of four experimental conditions: One fourth of the participants ($n = 49$; 24 men, 25 women) were exposed to a supraliminal sexual prime, one fourth ($n = 48$; 24 men, 24 women) to a supraliminal neutral prime, one fourth ($n = 50$; 25 men, 25 women) to a subliminal sexual prime, and one fourth ($n = 50$; 25 men, 25 women) to a subliminal neutral prime. The pictures and the temporal parameters of the subliminal and supraliminal priming were identical to those described in Study 1.

Immediately after the priming procedure, participants completed the Hebrew version of the Willingness to Sacrifice questionnaire, which asked them to list, in order of importance, the four most important domains or activities in their life other than their romantic relationship. (They listed such things as family, education, work, friends, or pastimes such as hobbies and entertainment.) Then, for each activity on the list, participants were asked to imagine that it was not possible to engage in that activity while maintaining a relationship with their partner. Each participant rated the extent to which he or she would consider ending the relationship with his or her partner to retain the activity: "Imagine that it was not possible to engage in *Activity* __ (numbered 1-4) and still maintain your relationship with your partner. To what extent would you consider ending your relationship with your partner?" The ratings were made on an 8-point scale ranging from 0 (*definitely would not*

TABLE 2: Means and Standard Deviations on Willingness to Sacrifice as a Function of Prime Type, Awareness of Prime, and Gender (Study 2)

| | Sexual Prime | | Neutral Prime | |
|--------------|--------------|------|---------------|------|
| | Women | Men | Women | Men |
| Subliminal | | | | |
| M | 4.38 | 5.95 | 4.00 | 5.15 |
| SD | 1.65 | 1.44 | 1.53 | 1.62 |
| Supraliminal | | | | |
| M | 3.34 | 5.07 | 4.50 | 4.77 |
| SD | 1.40 | 1.77 | 1.91 | 1.60 |

NOTE: The response scale ranged from 1 to 7.

consider ending the relationship) to 8 (definitely would consider ending the relationship). In the current sample, Cronbach's alpha for the four items was .76. Thus, the final score was averaged across the four statements and reversed to represent greater willingness to sacrifice.

Results and Discussion

To test our first hypothesis, we conducted a three-way ANOVA, with prime type (sexual vs. neutral), awareness of prime (subliminal vs. supraliminal), and gender (male vs. female) as the independent variables and willingness to sacrifice as the dependent variable. The means and standard deviations are shown in Table 2. The analysis revealed a main effect of gender, $F(1, 188) = 25.25, p < .001, \eta^2 = .11$, such that men reported greater willingness to sacrifice for their partner ($M = 5.24$) than did women ($M = 4.06$). There were no other significant main effects ($F < 1$). The analysis also revealed two 2-way interactions, one between prime type and awareness of the prime, $F(1, 188) = 5.01, p < .05, \eta^2 = .03$, and the other between prime type and gender, $F(1, 188) = 4.26, p < .05, \eta^2 = .03$. No other interactions were significant.

A simple main effects analysis, conducted to examine the interaction between prime type and prime awareness, revealed that willingness to sacrifice was higher after subliminal sexual priming ($M = 5.17$) than after subliminal neutral priming ($M = 4.58$), $F(1, 188) = 4.76, p < .05, \eta^2 = .03$. No significant difference was found between sexual and neutral priming when conducted supraliminally, $F < 1$. Another simple main effects analysis was conducted to examine the interaction between prime type and gender. It revealed that a gender difference in willingness to sacrifice occurred only when participants were exposed to a sexual prime (men: $M = 5.51$; women: $M = 3.86$), $F(1, 188) = 27.32, p < .01, \eta^2 = .11$, not when they were exposed to a neutral prime (men: $M = 4.25$; women: $M = 4.25$), $F < 1$.

As in Study 1 and as predicted in this study, subliminal sexual priming increased prorelational tendencies, whereas supraliminal sexual priming did not. Men were (self-reportedly) more willing to sacrifice for their partners, as in previous studies (Powell & Van Vugt, 2003), but only after subliminal exposure to a sexual stimulus.

STUDY 3

The purpose of Study 3 was to examine the effects of subliminal sexual priming on the cognitive accessibility of intimacy-related material. According to Reis (1990), intimacy is important for the development of a close relationship because potential members of a couple typically become and feel more intimate with each other, psychologically and physically, as they move toward becoming more deeply involved with each other. We therefore expected that subliminal sexual priming would increase a person's proneness to engage in intimate interpersonal interactions as reflected in the cognitive availability of intimacy-related thoughts.

We used an implicit measure of intimacy motivation to contrast with the explicit measures of willingness to self-disclose or self-sacrifice used in Studies 1 and 2: cognitive accessibility (in an incidental memory task) of previously encountered intimacy-related statements. Greater cognitive accessibility of intimacy-related thoughts was assumed to reflect stronger activation of motives for closeness and intimacy. In this study we used only subliminal priming, in a 2 (prime type: sexual vs. neutral) \times 2 (gender: male vs. female) between-subjects experimental design. The study included three parts: priming, rating of intimacy-related sentences (which would subsequently be tested for recognizability), and a recognition test for the sentences. We hypothesized that subliminal exposure to sexual stimuli would lead to increased cognitive accessibility of intimacy-related material, which would result in greater accuracy on an intimacy-related sentence-recognition task.

Method

Participants. Seventy-eight self-reported heterosexual students from Bar-Ilan University in Israel participated for either a monetary reward or course credit. The sample included 39 men and 39 women, aged 18-36 ($Mdn = 24$), all in a significant romantic relationship (3 months to 20 years, with a median of 30 months). The aim of the experiment was explained beforehand, and only students who were willing to be exposed to sex-related pictures or words participated (no one declined to participate). ANOVAs and chi-square tests revealed no significant gender differences on the demographic variables.

Measures and procedure. Students were invited to participate individually in an experiment involving decision making. (The description of the procedures was similar to the one used in Study 1.) After receiving the general instructions, participants were randomly assigned to one of two conditions: sexual prime ($n = 39$; 20 men, 19 women) or neutral prime ($n = 39$; 19 men, 20 women). They then performed 10 trials of the computerized furniture-comparison task described in Study 1, during which they were repeatedly exposed to the subliminal prime (once before each trial) associated with their experimental condition.

Upon completion of the priming procedure, participants received the following instructions:

In this part of the experiment you will be presented with 30 statements. Your task is to read each one and decide whether or not it describes you (and/or your romantic relationship). If you think it describes you, and you agree with it more than you disagree, please press the "Y" key. However, if you think it does not describe you and you disagree with it more than you agree, press the "N" key. Please make your decisions carefully and press only one key per trial.²

Of the 30 statements, 15 were intimacy related (they were taken from the Intimate Friendship Scale; Sharabany, 1994); for example, "I feel very close to my romantic partner." The other 15 statements were achievement related (they were taken from the Hebrew version of the Achievement Goals Questionnaire; Elliot & Church, 1997, translated by Kogut, 2002); for example, "I want to completely master the material presented in class."

Because we wanted to increase the likelihood that the prime would affect the recognizability of each statement, participants were exposed before each statement to the same prime used in the furniture-comparison task. Participants were told that before each statement they would notice a brief flash of light, which could be ignored. As in Study 1, the task was programmed using SuperLab Pro 2.0 and run on an IBM PC Pentium III computer with an SVGA color monitor. The primes were presented for 30 ms, followed immediately by a mask (a scrambled picture) for 500 ms. The target statement was then immediately shown on the screen until the participant pressed either Y (if it described him or her) or N (if it did not). When a key was pressed, the statement disappeared and a new trial began.

In the next part of the study, without preparation, participants were given a recognition test. They were asked to indicate whether each of 48 sentences presented individually on the screen in front of them had been presented earlier. All of the sentences (old and new) were related either to achievement or to intimacy. Participants received the following instructions:

TABLE 3: Memory Accuracy (d') for Intimacy-Related and Achievement-Related Sentences: Means and Standard Deviations as a Function of Prime Type and Gender (Study 3)

| | <i>Sexual Prime</i> | | <i>Neutral Prime</i> | |
|-------------------------------|---------------------|------------|----------------------|------------|
| | <i>Women</i> | <i>Men</i> | <i>Women</i> | <i>Men</i> |
| Intimacy-related sentences | | | | |
| <i>M</i> | 3.78 | 3.50 | 3.55 | 2.85 |
| <i>SD</i> | 0.82 | 0.62 | 0.96 | 1.10 |
| Achievement-related sentences | | | | |
| <i>M</i> | 2.73 | 2.91 | 2.59 | 2.56 |
| <i>SD</i> | 0.84 | 1.20 | 0.99 | 1.10 |

NOTE: The response scale ranged from 1 to 5.

In this segment of the study, we want to test your memory for the statements presented to you previously. A series of statements will be presented on the screen in front of you; some were seen before and some were not. If you think a statement is one you saw before, press the Y key; if you think it is a statement you didn't see before, press the N key.

Twenty-four of the 48 sentences were intimacy related; half of these were new and half had been presented before. Similarly, 24 sentences were achievement related; half of these had been presented before. Based on signal detection theory and the method proposed by Green and Swets (1966/1989), we calculated two d' scores as an index of memory accuracy: one for intimacy and one for achievement. After completing the computerized task, participants answered a few demographic questions and were then debriefed and asked whether they saw the prime (no one reported having seen it).

Results and Discussion

To test the hypothesis that sexual priming would increase the accessibility of intimacy-related thoughts, we conducted two 2-way ANOVAs. In each ANOVA, prime type (sexual vs. neutral) and gender (male vs. female) were the independent variables, and the dependent variables were (a) d' for intimacy-statement memory accuracy and (b) d' for achievement-statement memory accuracy. In each analysis the parallel dependent variable (e.g., memory accuracy for intimacy-related statements when predicting memory accuracy for achievement-related statements) was used as a covariate to reduce effects of response sets. Means and standard deviations for these analyses are presented in Table 3.

The ANOVA for intimacy-related recognition memory yielded a significant main effect of gender $F(1, 73) = 6.16$, $p = .01$, $\eta^2 = .09$. Women were more accurate than men

in recognizing intimacy-related sentences ($M_s = 3.67$ vs. 3.18), which fits with previous studies indicating that women emphasize intimacy in their relationships more than men do (e.g., Heller & Wood, 1998). The analysis also revealed a main effect of prime type, $F(1, 73) = 4.13$, $p < .05$, $\eta^2 = .05$, supporting our hypothesis. The sexual prime resulted in greater accuracy ($M = 3.63$) than the neutral prime ($M = 3.21$). The interaction of gender and prime type was not significant, and there were no effects on memory for achievement-related sentences, $F < 1$.

The results of Study 3 provide further support to the claim that subliminal sexual priming increases prorelational tendencies. These results were obtained using cognitive indexes rather than self-report measures, reducing the likelihood that our results are due to biases such as self-presentation, thereby increasing their generalizability.

STUDY 4

In Study 4, we examined the effects of subliminal sexual priming on a person's management of conflict. Preferring to resolve conflicts constructively, rather than avoid them or coerce a partner to accept one's own solutions, is an indicator of motivation to preserve a relationship (Simpson, Rholes, & Phillips, 1996). A person who wants to sustain a relationship tends to choose more positive strategies of conflict resolution, whereas one who cares little about the fate of the partnership may provoke, exacerbate, or fail to resolve conflicts (Rahim, 1992; Sanderson & Karetsky, 2002). If sexual priming increases preferences for constructive means of dealing with conflict, this will provide further support for the hypothesis that sexual priming activates prorelational motives, cognitions, and behaviors.

To test this hypothesis we used a 2 (prime: sexual vs. neutral) \times 2 (gender: male vs. female) between-subjects experimental design. As in the previous studies, the study included two parts: (a) a subliminal priming procedure (sexual or neutral) and (b) a questionnaire assessing conflict-resolution strategies (Rahim, 1983).

Method

Participants. One hundred self-reported heterosexual students from Bar-Ilan and Tel-Aviv Universities, 51 men and 49 women, aged 18-34 ($Mdn = 24$), all currently involved in a romantic relationship (lasting between 3 months and 14 years, with a median of 18 months), participated for either a monetary reward or course credit. The aim of the experiment was explained beforehand, and only people who were willing to be exposed to sex-related pictures or words participated

(no one declined to participate). ANOVAs and chi-square tests revealed no significant gender differences in the demographic variables.

Measures and procedure. After receiving the same kinds of instructions used in Studies 1-3, participants completed 10 trials of the furniture-comparison task. Before the task, they were randomly assigned to one of two groups: one that received the subliminal sexual prime (nude opposite-sex picture; $n = 52$; 26 men and 26 women) and one that received a neutral subliminal prime (abstract picture; $n = 48$; 25 men and 23 women).

Immediately after the furniture-comparison task, participants were asked to think for 2 min about conflicts in their romantic relationships. They were then asked to rate the degree to which various statements, describing different conflict-resolution strategies, characterized the way they would now approach such conflicts. The statements were presented on a computer screen. Participants received the following instructions:

In any relationship there are bound to be disagreements and conflicts. Please read each of the following statements, describing different possible ways to handle conflicts, and rate the extent to which each one describes the approach you would take. Please use the following rating scale, which ranges from 1 (*not characteristic of me*) to 5 (*very characteristic of me*).

Before reading each statement, participants were subliminally exposed to the same prime (sexual or neutral) they received while completing the furniture-comparison task. They were told that a brief flash of light, which they could ignore, would precede each statement. The task was programmed using SuperLab Pro 2.0 and run on an IBM PC Pentium III computer with an SVGA screen. The statements and primes were presented in the center of the screen on a white background, and the brightness and contrast were lowered. The primes were presented for 30 ms and then masked by a scrambled picture for 500 ms. Immediately after the mask the conflict-related statement was presented on the screen until the participant selected a response (by pressing a number between 1 and 5 on the computer keypad). When a number key was pressed, the statement disappeared and the next trial began automatically.

The statements were taken from the Hebrew version of the Rahim Organizational Conflict Inventory (ROCI-II; Rahim, 1983, translated by Sharir, 1996). Each statement describes one of five conflict-resolution strategies: integrating (e.g., "I try to cooperate with my partner to find a solution that is acceptable to both of us"), compromising (e.g., "I usually propose a middle ground for

TABLE 4: Preferences for Positive and Negative Conflict Resolution Strategies: Means and Standard Deviations as a Function of Prime Type and Gender (Study 4)

| Conflict Resolution Strategies | Sexual Prime | | Neutral Prime | |
|--------------------------------|--------------|------|---------------|------|
| | Women | Men | Women | Men |
| Positive strategies | | | | |
| <i>M</i> | 4.12 | 3.88 | 3.65 | 3.72 |
| <i>SD</i> | 0.39 | 0.50 | 0.50 | 0.59 |
| Negative strategies | | | | |
| <i>M</i> | 2.65 | 3.07 | 2.86 | 3.23 |
| <i>SD</i> | 0.54 | 0.39 | 0.50 | 0.42 |

NOTE: The response scale ranged from 1 to 7.

breaking deadlocks”), obliging (e.g., “I usually accommodate my partner’s wishes”), dominating (e.g., “I use my expertise to impose a decision in my favor”), and avoiding (e.g., “I usually avoid open discussion of my differences with my partner”). To test our hypotheses we divided the strategies into two categories: positive (integrating and compromising) and negative (obliging, dominating, and controlling). Cronbach’s alphas for the 11 statements describing positive strategies and the 17 statements describing negative strategies were .86 and .80, respectively. For each participant, we calculated two mean scores, one for each kind of strategy (positive and negative). High scores indicated a strong preference for a particular strategy. After rating each of the 28 items, participants completed the demographic questions, were debriefed about the study goals and manipulations, and asked whether they saw the prime (no one reported having seen it).

Results and Discussion

To examine the hypothesis that subliminal sexual priming would increase the endorsement of positive conflict-resolution strategies and decrease the endorsement of negative strategies, we conducted two 2-way ANOVAs, one for positive and one for negative strategies. Prime type (sexual vs. neutral) and gender (male vs. female) were the independent variables. Means and standard deviations for these analyses are presented in Table 4. The analysis for the tendency to use positive conflict-resolution strategies yielded a main effect for prime type, $F(1, 96) = 9.60, p < .01, \eta^2 = .11$. As predicted, subliminal sexual priming produced stronger endorsement of positive strategies ($M = 4.00$) than did neutral priming ($M = 3.69$). There were no other significant main effects or interactions.

The analysis for negative conflict-resolution strategies also produced a main effect for prime type, $F(1, 96) = 3.38, p = .05, \eta^2 = .03$. As predicted, subliminal sexual

priming lowered the endorsement of negative strategies ($M = 2.86$) compared with the neutral priming condition ($M = 3.05$). The analysis also revealed a main effect of gender, $F(1, 96) = 18.47, p < .01, \eta^2 = .16$, such that women ($M = 3.15$) displayed a weaker tendency to use negative strategies than did men ($M = 2.75$). The interaction between gender and prime type was not significant, $F < 1$.

As expected, subliminal exposure to a sexual stimulus led to a stronger preference for positive conflict-resolution strategies and a weaker preference for negative conflict-resolution strategies.

STUDY 5

Although Studies 1-4 provide consistent evidence for the positive effects of subliminal sexual priming on the motivation to initiate and maintain close relationships, they rely exclusively on pictures of a naked person to activate the sexual system. Therefore, their findings might be attributed to the activation of affiliative rather than sexual motives because, theoretically, seeing another (naked) human being may activate tendencies to approach and affiliate with the target person. Although the pictures seem to us unlikely to activate affiliative rather than sexual motivation, to rule out this possible alternative interpretation, in Study 5 we used an affiliation-unrelated sexual prime (the word *sex*) in the subliminal priming procedure and assessed its effects on participants’ preference for certain conflict-resolution strategies. If subliminal exposure to the word *sex* increases preference for constructive methods of conflict resolution, this will provide further support for the hypothesis that activation of sex-related representations motivates people to initiate and maintain close relationships. To test this hypothesis, we used a 2 (prime: sexual vs. neutral) \times 2 (gender: male vs. female) between-subjects experimental design. As in the previous studies, the study included two parts: (a) a subliminal priming procedure (sexual or neutral) and (b) a questionnaire assessing conflict-resolution strategies (Rahim, 1983).

Method

Participants. Sixty-eight self-reported heterosexual students from the University of Kansas, 47 women and 21 men, aged 18-30 ($Mdn = 18$), 43% currently involved in a romantic relationship (lasting between 3 months and 14 years, with a median of 18 months), participated for course credit. The aim of the experiment was explained beforehand, and only people who were willing to be exposed to sex-related pictures or words participated (no one declined to participate).

ANOVAs and chi-square tests revealed no significant gender differences in the demographic variables.

Measures and procedure. After receiving the same kinds of instructions used in Studies 1-4, participants completed 10 trials of the furniture-comparison task. Before the task, they were randomly assigned to one of two groups: one that received the subliminal sexual prime (the word *sex*, for 22 ms; $n = 38$; 11 men and 27 women) and one that received a neutral subliminal prime (the word *car*, for 22 ms; $n = 29$; 10 men and 19 women).³

Immediately after the furniture-comparison task, participants were asked to think for 2 min about conflicts in their romantic relationships. They were then asked to rate the degree to which various statements, describing different conflict-resolution strategies, characterized the way they would now approach such conflicts. The statements were presented using SuperLab Pro v4.02 on an IBM PC Pentium IV computer with an SVGA screen. Participants received the following instructions:

In any relationship there are bound to be disagreements and conflicts. Please read each of the following statements, describing different possible ways to handle conflicts, and rate the extent to which each one describes the approach you would take. Please use the following rating scale, which ranges from 1 (*not at all characteristic of me*) to 5 (*very characteristic of me*).

Before reading each statement, participants were subliminally exposed to the same prime (sexual or neutral) they received while completing the furniture-comparison task (similar to the procedure used in Study 4). The statements were from the English version of the ROCI-II (Rahim, 1983). Cronbach's alphas for the 11 statements describing positive strategies and the 17 statements describing negative strategies were .72 and .76, respectively. For each participant, we calculated two mean scores, one for each kind of strategy (positive and negative). High scores indicated a strong preference for a particular strategy. After rating the 28 items, participants completed the demographic questions, were debriefed about the study goals and manipulations, and asked whether they saw the prime (no one reported having seen it).

Results and Discussion

The study's hypotheses were examined with two 2-way ANOVAs, one for positive and one for negative strategies. Prime type (sexual vs. neutral) and gender (male vs. female) were the independent variables. Means and standard deviations for these analyses are presented in Table 5. The analysis for the tendency to use positive conflict-resolution strategies yielded a main effect for prime type, $F(1, 63) = 5.38, p < .05, \eta^2 = .08$.

TABLE 5: Preferences for Positive and Negative Conflict Resolution Strategies: Means and Standard Deviations as a Function of Prime Type and Gender (Study 5)

| Conflict Resolution Strategies | Sexual Prime | | Neutral Prime | |
|--------------------------------|--------------|------|---------------|------|
| | Women | Men | Women | Men |
| Positive strategies | | | | |
| M | 4.25 | 3.91 | 3.75 | 3.86 |
| SD | 0.53 | 0.30 | 0.41 | 0.40 |
| Negative strategies | | | | |
| M | 3.05 | 3.20 | 3.53 | 3.23 |
| SD | 0.50 | 0.39 | 0.54 | 0.31 |

NOTE: The response scale ranged from 1 to 7.

As predicted, subliminal sexual priming produced stronger endorsement of positive strategies ($M = 4.08$) than did neutral priming ($M = 3.80$). There were no other significant main effects or interactions.

The analysis for negative conflict-resolution strategies also produced a main effect for prime type, $F(1, 63) = 4.48, p < .05, \eta^2 = .07$. As predicted, subliminal sexual priming lowered the endorsement of negative strategies ($M = 3.13$) compared with the neutral priming condition ($M = 3.38$). There were no other significant main effects or interactions.

Thus, as expected, subliminal exposure to the word *sex*, which did not have a direct affiliative connotation, led to a stronger preference for positive conflict-resolution strategies and a weaker preference for negative conflict-resolution strategies.

GENERAL DISCUSSION

Overall, the five studies provide consistent support for the general idea that exposure to a sexual stimulus motivates people to initiate and maintain close relationships. As expected, sexual priming led to greater willingness to self-disclose and sacrifice for one's partner or relationship, greater accessibility of intimacy-related thoughts, and greater preference for positive over negative conflict-resolution strategies. Also in line with our predictions, these changes occurred more often following *subliminal* rather than *supraliminal* sexual priming. This seems likely to have occurred because subliminal exposure bypasses conscious beliefs and attitudes about sexuality and socially appropriate reactions to sexual stimuli (Janssen & Bancroft, 2006). It is interesting that despite the few gender differences across the five studies, subliminal sexual primes seem to have similar effects on men and women.

Although these findings are preliminary in the sense that no previous research has explored the possibility

that exposure to sexual stimuli has systematic effects on motivation to engage in particular kinds of relational, not just sexual, behavior, the consistency of the effects are striking. They suggest that even very basic and unconscious sexual stimulation (subliminal exposure to an attractive opposite-sex nude of reproductive age, or a sex-related word) activates relationship-related motives, causing people to become more interested in, or inclined to, engage in behaviors that would foster initiation and maintenance of a more extended couple relationship. Theoretically speaking, activation of the sexual system, which previous extensions of attachment theory have portrayed as one of three behavioral systems involved in romantic pair-bonding (the other two being attachment and caregiving; Shaver, Hazan, & Bradshaw 1988; Shaver & Mikulincer, 2006), moves a person in the direction of the other two systems' goals. Other recent studies (e.g., Gillath & Schachner, 2006) have shown that activation of the attachment system motivates people to pursue one kind of sexual strategy rather than another and makes them more compassionate and caring (e.g., Mikulincer, Shaver, Gillath, & Nitzberg, 2005). This suggests that at least in young adults, the three behavioral systems affect one another, possibly in the ultimate service of reproduction and the survival of offspring.

The major function of the sexual system is to pass genes from one generation to the next, and its innate aim is to have sexual intercourse with an opposite-sex partner and either become pregnant oneself (in the case of women) or impregnate a partner (in the case of men; Buss & Schmitt, 1993). However, for offspring to be born, several events must occur, including, in the case of human beings, two people meeting, developing some kind of relationship, and having sexual intercourse. Thus, it seems likely that activation of the sexual system automatically motivates people to take specific necessary steps that facilitate reproduction. Such steps include (a) initiating a relationship, that is, finding a potential sexual partner and, in many cases, remaining involved with the partner at least until conception or birth occurs; (b) sustaining motivation to have sex with that person so that if one copulation does not result in pregnancy, additional attempts will often be made, thereby increasing the likelihood of fertilization; and, at least in many cases, (c) maintaining a couple relationship so that offspring (who are helpless and dependent) have improved conditions for survival and successful development. These steps can be conceptualized as subgoals of the sexual behavioral system (*initiation, continuing motivation, and maintenance*; Birnbaum & Gillath, 2006). The studies reported here provide preliminary support for two of these subgoals, indicating

that sexual activation motivates people to get closer to a potential mate (through heightened self-disclosure) and to engage in behaviors that promote relationship maintenance (self-sacrifice for a partner's benefit, adopt prorelational conflict-resolution strategies).

Despite the coherence of our findings, one might argue that they are a mere reflection of general arousal, positive mood, or affiliative tendencies. However, as mentioned before, numerous studies have demonstrated that exposure to sexual pictures does activate the sexual system and heighten self-reports of sexual arousal and objective measures of genital responses (e.g., Both, Spiering, Everaerd, & Laan, 2004; Dekker & Everaerd 1988; Laan & Everaerd, 1995; Spiering et al., 2003; Stoléru et al., 1999). Moreover, Gillath et al. (2006) found that exposure to erotic pictures produced a different pattern of brain activation than did exposure to positively valenced, nonsexual pictures. Finally, Study 5 provides further support that it is the sex component rather than affiliation that generates the reported motivations or behavioral tendencies.

Nevertheless, it is important to mention that our findings are based mainly on self-reports and not actual instances of self-disclosure or sacrifice and that we do not know how the small changes in self-report measures as a result of sexual priming would translate into changes in real-world relationship behavior. Moreover, the effect sizes in our studies are relatively small; therefore, the results, until replicated, should be viewed as provocative rather than unarguable. Future studies should include physiological and behavioral measures of relationship-related behavioral tendencies. Such measures could include activation of approach-oriented brain regions and actual attempts to meet with and date a new partner following exposure to a sexual prime (e.g., Dutton & Aron, 1974). Replicating our findings with such measures would provide evidence that we did not change only reports but also actual tendencies.

Overall, although preliminary, the findings proved strikingly replicable and coherent across five studies. They raise new topics for research on the synergy between sexual stimulation and motivation to form and sustain a couple relationship. They suggest that activating sex-related representations influences people's motives and behavior in ways that, in the environment of evolutionary adaptation (Bowlby, 1969/1982), would have increased reproductive success through a combination of mating, reproduction, and shared rearing of offspring. How this synergy between sexuality and relationship maintenance works, how it varies depending on personality and environmental conditions, and how it can best be conceptualized in terms of the interplay of distinct behavioral systems are important topics for future research.

NOTES

1. To assess whether the sexual prime activates sex-related representations rather than mere affiliation tendencies, we asked 21 independent raters, who did not participate in the current studies (13 women, aged 18-40, $Mdn = 22.5$), to rate the pictures on sexuality and friendliness using a 7-point scale (1 = *not at all*, 7 = *very much*). These ratings revealed that the sexual pictures were rated as highly sexual (picture for men: $M = 6.34$, $SD = 1.01$; picture for women: $M = 6.52$, $SD = 0.87$), and not particularly friendly (picture for men: $M = 2.52$, $SD = 1.75$; picture for women: $M = 2.95$, $SD = 1.50$). The control abstract picture was rated as nonsexual ($M = 1.00$, $SD = 0.00$) and relatively low in friendliness ($M = 1.95$, $SD = 1.86$). The pictures are available from the first author upon request.

2. We checked to see whether prime type significantly affected the number of times people found the sentences self-descriptive or not self-descriptive, and no differences were obtained.

3. The words for Study 5 were chosen using a pretest in which 20 participants (11 women, aged 18-32, $Mdn = 21$) who did not participate in Study 5 rated various words on how sexual and how friendliness related they were. Ratings were made on a 7-point scale (1 = *not at all*, 7 = *very much*). The word *sex* was rated high on sexuality ($M = 6.80$, $SD = 0.41$) and low on friendliness ($M = 2.40$, $SD = 1.95$), whereas the neutral word *car* was rated low on sexuality ($M = 1.10$, $SD = 0.45$) and as low on friendliness as the word *sex* ($M = 2.35$, $SD = 1.82$).

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Received December 27, 2006

Revision accepted January 10, 2008