

Does Subliminal Exposure to Sexual Stimuli Have the Same Effects on Men and Women?

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Three studies explored gender differences in explicit and implicit components of sexual arousal following brief exposure to a sexual stimulus. Whereas Study 1 assessed reports of sexual arousal following subliminal exposure to a sexual or a neutral picture, Studies 2 and 3 examined the effects of the same priming procedure on accessibility of sex-related thoughts assessed with a pictorial judgment task and a lexical decision task. The subliminal sexual prime did not have an effect on men's reports of sexual arousal, but caused women to report lower levels of sexual arousal. In contrast, the same subliminal sexual prime led to higher accessibility of sex-related thoughts in both men and women. It is therefore suggested that the subliminal sexual prime causes women to activate sex-related mental contents but to experience the result as somewhat aversive.

The nature of sexual arousal has concerned researchers for years. Ever since Freud (1935, 1949, 1950), researchers have tried to determine what accounts for individual differences in arousal reactions to sexual stimuli (e.g., Barlow, Sakheim, & Beck, 1983; Basson, 2002; Carmen, 1992; Green & Mosher, 1985). Responses to sexual stimuli are often complex, because they are determined by various presumably innate processes as well as cultural prohibitions and personal history. Sexual stimuli can evoke anxiety, shame, or guilt, which can inhibit or interfere with sexual arousal. Recently, Janssen, Everaerd, Spiering, and Janssen (2000) proposed and presented evidence for a conceptual model of implicit and explicit processing of sexual stimuli. However, both the model and the empirical studies supporting it focused mainly on male sexuality. Consequently, there is only a minimal amount of evidence concerning the applicability of the model to women's sexual arousal (Spiering, Everaerd, & Laan, 2004). The purpose of the studies reported here was to further explore the generalizability of Janssen et al.'s (2000) model to both men and women by examining gender differences in the effects of exposure to subliminal sexual stimuli.

Sexual arousal is a complex phenomenon involving physiological, psychological (cognitive and affective),

and behavioral responses (Rosen & Beck, 1988). Each kind of response seems to be activated by a particular kind of stimulus or aspect of a complex stimulus, and the different kinds of response are not perfectly coordinated or synchronized. For example, whereas genital responses (e.g., changes in penile circumference, amplitude of vaginal pulse) are easily elicited by a wide variety of sexual stimuli (e.g., Cranston-Cuevas & Barlow, 1990; Heiman & Rowland, 1983; Laan & Everaerd, 1995), self-reports of sexual arousal (e.g., Mosher's multiple indicators; Mosher, Barton-Henry, & Green, 1988) are affected by situational factors (the presence of other people, laboratory versus bedroom context, romantic versus nonromantic context, etc.) and may indicate low arousal even when genital responses are strong (e.g., Janssen, Everaerd, van Lunsen, & Oerlemans, 1994; Laan, Everaerd, Bellen, & Hanewald, 1994; see Laan & Everaerd, 1995, for a review). Such differences suggest that different kinds of responses to sexual stimuli are attributable to different mechanisms (e.g., Bancroft, 1989).

Although scholars (e.g., Barlow, 1986; Byrne, 1977; Palace, 1995) have recognized the complexities of physiological and psychological responses to sexual stimuli, few have explained the different mechanisms underlying this complexity. In one such effort, Janssen et al. (2000) proposed an information processing model explaining how the various kinds of sexual responses depend on the joint action of automatic and controlled

mental processes (see also, Geer & Janssen, 2000; Janssen & Everaerd, 1993). According to their model, automatic or pre-attentive processes form a major pathway to sexual arousal, which enables fast recognition of the sexual meaning of a stimulus and the generation of automatic, uncontrolled, and at least partially unconscious cognitive responses (e.g., increased cognitive availability of sex-related concepts) and physiological responses (e.g., blood flow to the genitals). This primary pathway can be modified by controlled, deliberate mental processes, which occur at a higher cognitive level and are thought to be relatively slow, more resource-consuming, and at least partially conscious. These mental processes follow from the activation of sex-relevant nodes in a person's semantic association network (including, for example, sexual schemas, sexual memories, and mental representations of sex-related cultural norms), and they determine the evaluative valence (positive or negative) attached to a particular sexual stimulus and the extent to which the automatic arousal responses are acknowledged in conscious experiences of sexual arousal and sexual urges.

In their study, Janssen et al. (2000) focused on automatic processes while examining the hypothesis that sexual stimuli (pictures of nude individuals of the opposite sex) presented subliminally (thereby limiting conscious access to the causes of arousal) would automatically activate sexual nodes in a person's semantic association network. They asked male research participants to categorize target pictures as sexual or neutral, and to do so as quickly as possible. Each target picture was preceded by subliminal presentation of either a sexual or a neutral picture. The time it took the subjects to decide on the category (sexual, neutral) was used as an index of the cognitive accessibility of sex-related thoughts and memories. In line with Janssen et al.'s (2000) hypothesis, subliminal exposure to sexual stimuli led to faster categorization of sexual pictures as sexual rather than neutral. This finding was interpreted as evidence for sexual priming, that is, priming sex-related associative networks, which then helped participants encode the sexual aspects of consciously encountered stimuli.

In a subsequent study, Spiering, Everaerd, and Janssen (2003) replicated Janssen et al.'s (2000) results but found that subliminal exposure to sexual stimuli did not increase participants' reported level of sexual arousal, despite the fact that it facilitated the categorization of sexual pictures. In contrast, when the same sexual stimuli were presented supraliminally, so that they could be perceived and evaluated consciously, participants were slower at categorizing the stimuli as sexual but their level of reported sexual arousal was higher. According to Spiering et al. (2003), these findings imply that subjective sexual arousal depends on conscious processing of sexual stimuli. They concluded their article by saying that although the findings supported Janssen et al.'s (2000) model by showing that automatic and controlled processes have different effects, further research

on the underlying automatic and controlled processes should be conducted.

In another follow-up study, Spiering et al. (2004) exposed both men and women to supraliminal neutral and sexual primes, either romantic or "explicit" (i.e., sexual without being romantic), and asked study participants to categorize a subsequent picture as sexual or neutral or, in a separate set of trials, to rate their sexual arousal related to viewing the picture. For both men and women, the supraliminal sexual prime increased the time taken to classify the sexual pictures as sexual. In general, men rated themselves as more aroused than women, but among women the romantic sexual primes led to higher rated sexual arousal than the nonromantic sexual primes, suggesting that the explicitly sexual primes had a negative effect.

To date, studies using subliminal sexual priming have generally involved only male participants. Therefore, the current set of studies focused on men's and women's reactions to subliminal sexual priming. On the basis of existing research and theorizing, we predicted that subliminal exposure to sexual stimuli would result in similar levels of automatic activation of sex-related thoughts among men and women, because both men and women should associate nude opposite-sex individuals with the category "sex" and its many associated concepts. At the same time, it was not clear what effect subliminal sexual priming might have on women's reported levels of sexual arousal in response to consciously encountered target pictures of naked men. In the study by Spiering et al. (2003), subliminal primes had no additional arousing effect on men, but the authors did not study the effects on women. If subliminal exposure to an opposite-sex nude raises sexual arousal without activating conscious negative attitudes, it might increase women's arousal in response to consciously encountered pictures of men. But if subliminal exposure to an opposite-sex nude automatically activates negative concepts or schemas related to sex (or, perhaps, sex with a suddenly encountered naked stranger), then it might reduce women's consciously reported sexual arousal. We therefore made no a priori prediction about women's reaction (increased or decreased reported sexual arousal) to consciously encountered pictures of naked men.

Study 1

The purpose of Study 1 was to examine the effects of subliminally presented sexual stimuli on participants' conscious reports of sexual arousal and to look for possible gender differences in these effects. Specifically, participants were exposed subliminally (for 30 milliseconds (ms)) to either a sexual prime (a picture of a nude person of the opposite sex) or a neutral prime (an abstract artwork), and were then asked to rate the extent to which they were sexually aroused while watching another set

of pictures of nude individuals of the opposite sex (target pictures). The procedure was based on previous research by Wright and Adams (1999) and Janssen et al. (2000). In light of Murnen and Stockton's (1997) review of the literature on sexual arousal, and in accordance with Janssen et al.'s (2000) and Wright and Adams's (1999) studies, we decided to operationalize the notion of "sexual stimulation" by using sexually suggestive pictures of members of the opposite sex, but not pictures that showed genitalia or were likely to seem pornographic.

We based our procedure on both Janssen et al.'s (2000) and Spiering et al.'s (2003) procedures. As in the Spiering et al. (2003) study, primes were presented only once before each conscious target picture was rated with respect to its ability to evoke sexual arousal. Also as in that study, we used a short exposure time for the implicit prime, and the prime was preceded and followed by a "mask" (a scrambled picture), which ensured that the stimulus exposure was limited to 30 ms (cf. De Groot & Nas, 1991; Forster & Davis, 1984). Unlike Janssen et al. (2000) and Spiering et al. (2003), we did not use individually determined subjective perceptual thresholds (Cheesman & Merikle, 1984, 1986), because masked subliminal primes were successfully used, for all participants, in several of our previous studies (e.g., Mikulincer, Birnbaum, Woddis, & Nachmias, 2000; Mikulincer, Gillath, & Shaver, 2002). Also, we used only one picture for each gender as a prime, because the two pictures were based on extensive pilot testing. That testing was done to make sure the pictures were generally viewed as sexually arousing without being disturbing to people from the participant population.

Study 1 employed a within-subject block design, in which all participants were subliminally exposed to each of the two primes (sexual, neutral) in separated blocks of 12 trials. Since the duration of the subliminal priming effect was unknown, we used a block design to avoid possible "carryover" effects that might occur if sexual and neutral primes were randomly presented in close proximity to each other. By blocking trials of one kind, any carryover effects would have simply added to the effects of a particular stimulus type within a block. Thus, the target pictures were presented twice to each participant, once following the sexual prime and once following the neutral prime. The order of trial blocks (sexual prime first or neutral prime first) was counterbalanced across participants. The independent variables in Study 1 were type of subliminal prime (sexual, neutral) and participant's gender (male, female). The dependent variables were participants' average ratings of their sexual arousal while looking at the target pictures in each of the two conditions (or blocks). In line with Spiering et al. (2003), we expected the subliminal sexual prime to have little effect on men's self-reported sexual arousal, which overall was expected to be high. We were uncertain what to expect in the case of women, because their arousal reactions to subliminal sexual primes have not been

examined in previous studies. Overall, because the literature generally portrays women as reporting less sexual arousal than men under most laboratory conditions, we expected them to have, overall, lower self-reported arousal than men. This expectation is based, however, on studies conducted mainly in the United States or Europe, so they depend to some extent on sexual norms and attitudes in those parts of the world. There are few such studies conducted in Israel, where our own experiments took place.

Method

Participants. Forty self-reported heterosexual students from Bar-Ilan University in Ramat Gan, Israel, 17 men and 23 women aged 21–34 (median = 25),¹ participated in the study without monetary reward. All of them reported having had previous sexual experience. None of them had a history of sexual problems (such as impotence, vaginismus, etc.). The nature of the experiment was explained at the beginning, so that only students who were willing to be exposed to sexually provocative pictures participated. Only one potential female participant declined to participate.

Prime and Target Stimuli. The sexual prime and target pictures were selected based on the following criteria: they were not likely to be viewed as disgusting or offensive, they were not pornographic (i.e., did not involve intercourse, display of genitals, or violence toward or derogation of one gender by the other), and were suitable for both supraliminal and subliminal presentation. In addition, whereas the unseen sexual prime was likely to be highly sexually arousing, the target pictures were only moderately arousing, to avoid ceiling effects and allow the sexual prime to raise the conscious level of sexual arousal attributed to the influence of the pictures.

The pictures were taken from a variety of sources (e.g., Internet galleries), were presented in black-and-white, measured 10 × 10 cm, appeared in the center of a computer screen, and depicted only one nude person against a neutral background. When choosing the pictures we attempted to control for level of physical attractiveness, apparent education and SES, age, height, and weight—all factors found in previous studies to affect subjective ratings of desirability (e.g., Shaver, Hazan, & Bradshaw, 1988).

In order to select the most appropriate sexual prime and target pictures, we conducted a series of preliminary studies in which different samples of participants from the local student population rated the sexually arousing qualities of the pictures. In the first preliminary study, 40 self-reported heterosexual students (25 women, 15 men) attending Bar-Ilan University were asked to rate 25 pictures of nude people of the opposite sex. After seeing each picture, participants rated the level of sexual arousal it created on five separate scales (worded in

terms of the Hebrew equivalents of sexual, sensual, hot, arousing, and a turn on). The items were taken from the Multiple Indicators of Subjective Sexual Arousal (MISSA) questionnaire (Mosher, Barton-Henry, & Green, 1988). Ratings were recorded on 7-point scales, ranging from “not at all” (1) to “very much” (7). In addition, participants rated other characteristics of each pictured person that have been found to affect attractiveness and might be confounded with capacity to elicit sexual arousal. Specifically, they rated the person depicted in the picture in terms of his or her attractiveness (from 1—not attractive at all, to 5—very attractive), age (young, adult, old), weight (from 1—very thin, to 5—very fat), height (short, average, tall), public image (from 1—“loser/failure” to 5—“winner/successful”), socio-economic status (from 1—very low, to 5—very high), education (low, average, high), and appeal as a potential romantic partner (yes, no).

Based on participants' ratings, we selected six target pictures, all of which were rated as moderately arousing on the five scales described above (with average ratings ranging from 2.99 to 4.09) and did not differ from the other pictures on the other assessed variables. In selecting the two prime pictures, one for each gender, we decided to choose ones that received ratings above 4.10 on the five sexual arousal scales and ratings between 3.00 and 4.00 on the nonsexual scales (e.g., education). Thirteen of the 25 pictures depicting nude men and 13 of the 25 pictures depicting nude women fulfilled these criteria and were retained for further examination.

In the second preliminary study, 20 additional participants (10 men, 10 women) judged the degree of sexual arousal these pictures evoked, and we selected the picture of a woman that received the highest sexual arousal rating among men ($M = 5.1$) and the picture of a man that received the highest sexual arousal rating among women ($M = 4.36$). These pictures were used as the subliminal sexual primes for men and women, respectively.

Procedure. Participants were invited to participate individually in an experiment on “cognitive and emotional judgment” in which they would complete a series of computerized tasks that might involve exposure to sexual pictures. After receiving these general instructions, participants signed an informed consent agreement and were told that they would perform a computerized picture judgment task in which they would rate their level of sexual arousal while watching pictures presented on a computer screen. (The instructions for this and the subsequent two studies are shown in the Appendix.)

The task was run on a Pentium IBM-PC, with an SVGA color monitor, and was programmed using Superlab software (Cedrus Co., San Pedro, CA). Brightness and contrast were set somewhat low, and the primes as well as the target pictures were displayed in

black-and-white on a white background in the middle of the screen. Participants worked at their own pace, completing three practice trials followed by 12 experimental trials. The pictures in the practice trials were neutral in content. The target pictures were the 6 pictures depicting naked people of the opposite sex that had been chosen in the preliminary studies. These 6 pictures appeared twice, once after subliminal exposure to a sexual prime, and once after subliminal exposure to a neutral prime (as already mentioned, the order of the blocks was randomized across participants).

Each trial consisted of a rapid, forward and backward masked, subliminal presentation of one of two primes (opposite-sex sexual picture, neutral abstract art picture) followed, after a pause of 500 ms (during which the backward mask appeared), by one of the 6 target pictures (for 3000 ms). On each trial, the prime was presented for 30 ms (enough time for the entire picture to be presented at least once, using a refresh rate of 85 MHz), which was not long enough for the participants to perceive it consciously (e.g., Mikulincer, 1998).

Participants were told that each trial would begin with an “X” in the middle of the screen (the forward mask), that they should keep their eyes focused on it, and that it would be followed by a flash of light, which they should ignore. Then, after a brief pause, an abstract target picture would appear. Because the afterimage of a stimulus presented even for as little as 30 ms can remain active in the peripheral visual system for much longer, the primes were masked for 500 ms by a scrambled picture (which was tested in a preliminary study and found to be perceived as vague and neutral). The mask was the same size as the prime pictures. The stimulus parameters were similar to those used successfully in prior studies (e.g., Mikulincer et al., 2000; Murphy & Zajonc, 1993). Mikulincer et al. (2000) found that participants are not able to detect the subliminal primes even after repeated presentations. In the debriefing stage of the present study, participants were asked whether they had seen a picture in the area of the flashing light. Only one participant said she had, and her data were excluded from the analyses.

Following each target picture, participants were asked to answer the following question, which was presented on the computer screen: “After looking at the picture, how sexually aroused are you?” Ratings were made on a 7-point scale ranging from “not at all aroused” (1) to “extremely aroused” (7). Participants were asked to make their ratings by pressing the appropriate number on the keyboard, after which the question disappeared from the screen and the next trial began. Cronbach alpha coefficients for ratings of sexual arousal across the 6 target pictures in each priming condition (sexual, neutral) indicated adequate internal consistency (.81, .78). Hence, two global scores were computed for each participant by averaging the 6 ratings in each subliminal priming condition (sexual, neutral). Higher scores indicate stronger sexual arousal.

Results and Discussion

The data were analyzed with a two-way analysis of variance (ANOVA), with gender (female, male) and prime condition (sexual, neutral) as the factors and ratings of sexual arousal as the dependent variable.² Prime condition was treated as a within-subject repeated factor. This analysis yielded no significant main effects for prime condition or gender. However, the interaction between prime condition and gender was significant, $F(1, 36) = 8.15, p < .01, \eta^2 = .12$. A test for simple main effects for repeated measures (alpha level = .05) revealed a significant effect for prime only among women, $F(1, 36) = 6.25, p < .05$, but not among men, $F < 1$. The subliminal sexual prime resulted in women rating themselves as *less* sexually aroused by the nude male pictures than they said they were when they rated the pictures following the neutral prime (see means in Table 1). Additional simple main effect tests revealed gender differences in sexual arousal ratings only after a subliminal sexual prime, $F(1, 36) = 8.43, p < .01$, but not after a subliminal neutral prime, $F < 1$. As can be seen in Table 1, whereas no notable gender difference was found in reports of sexual arousal following a neutral prime (suggesting little gender difference in conscious guilt, shame, prudishness, etc.), women reported lower sexual arousal than men following subliminal exposure to a sexual prime.

Overall, the findings were in line with Spiering et al.'s (2003) results showing that men reacted to subliminal sexual stimuli with no notable increase in conscious reports of sexual arousal. Most noteworthy, however, was the finding that women reported lower sexual arousal following exposure to a subliminal sexual stimulus (a picture that women from the same university had rated as arousing). This suggests either that the prime led, unconsciously, to activation of negative thoughts or feelings of some kind, or that the women interpreted their arousal as uncomfortable or negative for some reason. Whatever the precise explanation of the gender difference, it clearly indicates that the results from subliminal sexual priming studies based only on men cannot be extended without qualification to women.

Having obtained this gender difference, we next asked whether it would also be observed in automatic cognitive responses to subliminal sexual stimuli, which

Spiering et al. (2004) found to occur in both men and women when supraliminal sexual primes were used. We adopted two approaches to measuring the effects of subliminal priming on cognitive processes, one using picture classification (Study 2) and one using a lexical decision task (Study 3).

Study 2

In Study 2 we examined the effects of a subliminal sexual prime on a picture-categorization task involving sexual and nonsexual stimuli. Whereas Study 1 relied on an explicit measure of sexual arousal (self-reports of sexual arousal while viewing pictures depicting opposite-sex nudes), Study 2 assessed the cognitive accessibility of sex-related thoughts using a picture categorization task similar to the one used by Janssen et al. (2000, Study 2). In this task, participants were exposed to a series of pictures and were asked to decide whether each one was or was not sexual, and to do so as quickly and accurately as possible. Reaction time (RT) for deciding whether a picture contained sexual content was taken as an index of the accessibility of sex-related thoughts—the shorter the RTs, the more accessible the sex-related thoughts (Janssen et al., 2000).

Participants were subliminally exposed to either the sexual or the neutral primes described in Study 1 and were then immediately asked to decide whether a consciously seen picture contained sexual content or not. The target pictures were 10 photographs of opposite-sex nudes drawn from the pool of sexual pictures described in Study 1, and 10 neutral pictures depicting abstract forms or landscapes. Unlike the sexual pictures used by Janssen et al. (2000), which included couples in sexual positions or depictions of sexual intercourse, we chose less cognitively complex and demanding sexual pictures portraying only a single nude person.

Like Study 1, this experiment involved a within-subject block design in which all participants were subliminally exposed to two primes (sexual, neutral) in separate blocks. The independent variables in Study 2 were priming condition (sexual, neutral) and participant's gender (male, female). The dependent variable was RT for deciding whether a target picture was sexual or not. We predicted that the subliminal sexual prime, as compared with the neutral prime, would lead to shorter RTs for identifying sexual pictures as sexual, and that, in line with Spiering et al.'s (2004) findings using cognitive tasks and supraliminal sexual stimuli, there would be no gender differences in RTs.

Method

Participants. Thirty-eight self-reported heterosexual students from Bar-Ilan University, 18 men and 20 women aged 19–48 (median = 23), participated without

Table 1. Means and Standard Deviations (SDs) of Self-Reports of Sexual Arousal, Broken Down by Gender and Priming Condition

	Neutral prime	Sexual prime
Women		
M	5.27	4.87
SD	1.23	1.38
Men		
M	5.20	5.39
SD	1.36	1.19

monetary reward. The nature of the experiment was explained beforehand, and only students who were willing to be exposed to pictures of nude people or words with sexual connotations participated. (In this study, no one declined to participate.)

Measures and Procedure. The general instructions were identical to those used in Study 1. Participants were told that they would perform a computerized picture-categorization task. The task was based on the apparatus and procedure used by Janssen et al. (2000). All of the details concerning task programming and experimental procedure were the same as those described in Study 1. Participants first completed three practice trials and then 40 experimental trials. The pictures in the practice trials were neutral and different from those in the experimental trials.

Each trial consisted of a rapid subliminal presentation of one of two prime pictures (sexual, neutral) followed, after a pause of 500 ms (during which a mask was presented), by the presentation of a target picture (for 1000 ms). Participants judged as quickly as possible whether the picture was sexual or not by pressing “1” on the keyboard number pad if they thought the picture was sexual or “3” if they thought it was non-sexual. The picture then disappeared and the next trial began. The parameters used for the stimulus presentations were the same as those in Study 1. The target pictures consisted of 10 pictures of nude opposite-sex people that had been rated moderately high on capacity for sexual arousal in preliminary studies (see Study 1). Ten landscapes and abstract pictures were chosen as the neutral target pictures. Each picture was shown twice in a random order during the task, once following each prime (sexual, neutral). As in Study 1, the primes were presented in blocks so that the first 20 trials were either sexual or neutral and the last 20 trials included the previously unused prime picture. The sequence of blocks (sexual and neutral) was counterbalanced across participants. In the debriefing stage of this study, participants were asked whether they had seen a picture in the area of the flashing light, and all said they had not.

Results and Discussion

For each participant, RTs (for correct responses only) were averaged according to target picture (sexual, neutral) and type of prime (sexual, neutral). There were few errors in identifying sexual pictures as sexual, and 2-way ANOVAs revealed no significant effects of prime condition or gender on the number of errors for either type of picture (sexual, neutral). In addition, a preliminary 2-way ANOVA performed on the RTs for identifying neutral pictures as non-sexual revealed no significant main effect of priming condition and no significant interaction between gender and prime condition. However, the main effect for gender was statistically significant, $F(1, 36) = 6.69, p < .01$,

$\eta^2 = .14$. Men’s RTs for identifying neutral pictures as non-sexual were shorter ($M = 643.16, SD = 131.93$) than women’s RTs ($M = 770.52, SD = 190.97$).

In examining our main predictions, we conducted a two-way ANOVA with gender and priming condition (sexual, neutral) as the factors and RTs for correct categorization responses of sexual pictures as the dependent variable. Priming condition was treated as a within-subject repeated factor. In this analysis, we entered RTs for identifying neutral pictures as neutral as a covariate to control for the observed gender differences in neutral picture categorization. (Without this procedure, we would not know whether the gender difference for sexual stimuli was simply the same as the gender difference for neutral stimuli.) The ANOVA yielded a significant main effect for gender, $F(1, 35) = 5.17, p < .05, \eta^2 = .06$; men’s RTs for identifying sexual pictures as sexual were shorter (covariate-adjusted $M = 622.80, SD = 167.40$) than women’s RTs (covariate-adjusted $M = 734.98, SD = 179.26$). The main effect for priming condition was also significant, $F(1, 35) = 8.02, p < .01, \eta^2 = .18$. Supporting our predictions, the subliminal sexual prime led to shorter RTs for identifying sexual pictures as sexual (covariate-adjusted $M = 648.49, SD = 136.04$) than for identifying sexual pictures as sexual following a neutral subliminal prime (covariate-adjusted $M = 721.10, SD = 213.96$). The two-way interaction was not significant.

In sum, the two main findings were in line with our predictions. First, a subliminal sexual prime, compared with a neutral subliminal prime, led to higher accessibility of sex-related thoughts (shorter RTs for categorizing sexual pictures as sexual). Second, unlike the outcome of Study 1, there was not a significant interaction between gender and prime, implying that the sexual prime had similar effects on the cognitive accessibility of sex-related thoughts in men and women. Nevertheless, although there was not an interaction between gender and type of prime, there was a significant main effect of gender. Overall, men were faster than women in classifying both neutral and sexual pictures as neutral or sexual. But their relative speed in categorizing sexual pictures as sexual was greater even when the gender differences in speed of identifying neutral pictures as neutral was statistically controlled. Based only on this study, we cannot say whether the predicted findings generalize to other cognitive assessments besides picture categorization. To examine the validity and generalizability of the findings, we conducted a third study to examine the effects of subliminal exposure to sexual stimuli on the cognitive accessibility of sex-related thoughts while performing a lexical decision task.

Study 3

The purpose of Study 3 was to determine the accessibility of sex-related thoughts following subliminal sexual

priming, this time focusing on semantic (verbal) rather than pictorial stimuli. We used a lexical decision task, designed originally by Meyer and Schvaneveldt (1971), in which participants read strings of letters while trying to decide as quickly and accurately as possible whether the string is or is not a word. Reaction times are used as an index of the accessibility of thoughts related to the target words, with shorter reaction times implying greater accessibility (e.g., Fischler & Bloom, 1979; Mikulincer et al., 2002). In Study 3, the target words were related to sexuality and were presented after either a sexual or a neutral subliminal prime.

Stanovich and West (1983) demonstrated that a particular prime word presented just before a lexical decision is made can shorten the reaction times for target words associated with the prime (e.g., the target word “table” is primed by the preceding word “chair,” resulting in a shorter RT to indicate that “table” is a word rather than a string of scrambled letters). Moreover, priming effects are obtained even when the prime is presented subliminally (e.g., Forster, 1981). Thus, reaction time fluctuations in a lexical decision task reflect level of activation of target words caused by exposure to a prime, even when the prime is presented subliminally.

In Study 3, participants completed a lexical decision task with three different categories of target stimuli (sex-related words, neutral words, and non-words) while being exposed to a subliminal sexual prime in half of the trials and a neutral prime in the other half. We predicted that the subliminal sexual prime, compared with the neutral subliminal prime, would yield shorter RTs for sex-related words. We also predicted that this effect would occur for both men and women, thereby replicating Study 2.

Method

Participants. Forty-seven self-reported heterosexual students from Bar-Ilan University, 26 men and 21 women aged 21–49 (median = 24), participated without monetary reward. The nature of the experiment was explained beforehand, and all potential participants agreed to continue.

Measures and Procedure. The general instructions were the same as those used in Studies 1 and 2. Participants were also told they would perform a computerized lexical decision task. The task was based on the apparatus and procedure used by Baldwin, Fehr, Keedian, and Seidel (1993) and was similar to the task used by Mikulincer et al. (2002). All of the details of task programming and stimulus presentation were similar to those described in Study 1. Participants first completed 10 practice trials and then 80 experimental trials. The words and non-words in the practice trials were neutral and different from those used in the experimental trials.

In Study 3, each trial of the task consisted of a rapid subliminal presentation of one of two primes (sexual, neutral) followed, after a pause of 500 ms (during which a mask was shown), by the presentation of a target letter string (for 1000 ms). Participants judged as quickly and as accurately as possible whether the letter string was or was not a word by pressing “1” on the keyboard number pad if they thought the string was a word or “3” if they thought it was a non-word. The string then disappeared and the next trial began.

On each trial, the prime was presented for 30 ms. Participants were told that each trial would begin with an “X” in the middle of the screen, on which they should keep their eyes fixed, followed by a flash of light, which they should ignore. Then, after a brief pause, the target letter string would appear. To avoid the problem of an afterimage remaining active, we masked the primes with a scrambled picture immediately after the disappearance of the prime. In the debriefing period, participants were asked about the flash of light between the X and the string of letters, and the data of one participant, who said she did see something, without being sure what, were eliminated from the analyses.

The sexual and neutral primes used in Study 3 were identical to those used in Studies 1 and 2. The strings of letters included 20 strings of non-words (e.g., *btlea*), 10 strings of neutral words (e.g., *table*) and 10 strings of letters related to sex (e.g., *penis*). The sexual and neutral words were equated for length and frequency in Hebrew. Each string was shown twice, once following the sexual prime and once following the neutral prime, with the order being randomly determined for each participant.

In a preliminary study, 15 participants had rated 40 words, 20 sex-related and 20 neutral (non-sex-related) words. The words for the list were chosen by three independent judges (psychologists from the Psychology Department at Bar Ilan, Israel) and were all socially acceptable words from the Hebrew dictionary (similar to *penis* and *breast* in English), not vulgar slang terms. Participants were given the list of words and asked to rate the extent to which each word was sexual or had a sexual connotation on a 7-point scale, ranging from “not at all sexual” (1) to “very sexual” (7). For inclusion in Study 3, we chose 10 words that received ratings of 1 or 2 ($M = 1.31$, $SD = 0.23$) as neutral words, and 10 words that received ratings of 6 or 7 ($M = 6.51$, $SD = 0.20$) as sexual words.

Results and Discussion

For each person, RTs (for correct responses only) were averaged according to type of target stimuli (sexual words, neutral words, non-words) and type of prime (sexual, neutral). There were few errors in identifying words as words, and two-way ANOVAs for gender and priming condition yielded no significant effects for

the number of errors associated with the three types of target stimuli. Moreover, additional preliminary ANOVAs found no significant effects for gender or priming condition on RTs for neutral words and non-words.

To test our main predictions, we conducted a two-way ANOVA with gender and priming condition (sexual, neutral) as the factors and RTs for sexual words as the dependent variable. Priming condition was treated as a within-subject repeated factor. In this analysis, we entered RTs for neutral words and non-words as covariates in order to control for non-specific individual variations in lexical decision latencies. This analysis yielded a significant main effect for priming condition, $F(1, 43) = 6.40, p < .05, \eta^2 = .09$. Supporting our predictions, a subliminal sexual prime led to shorter RTs for sexual words (covariate-adjusted $M = 560.69, SD = 67.55$) than a neutral prime (covariate-adjusted $M = 586.05, SD = 78.42$). Neither the main effect of gender nor the two-way interaction between gender and priming condition were significant.

Overall, the findings of Study 3 were in line with Spiering et al.'s (2003) findings and the results of our Study 2. Consistent with our hypothesis, sexual priming heightened the cognitive accessibility of sex-related thoughts in a lexical decision task, and it did so equally for men and women. Interestingly, no significant main effect was found for gender, implying either that the overall gender differences observed in Study 2 were related to the modality of the task—pictorial identification—rather than the processing of sexual thoughts per se, or that by using formal, dictionary terms rather than less socially acceptable slang words we eliminated the gender difference in Study 3.

General Discussion

In the three studies reported here, we examined automatic and controlled components of sexual reactions while testing hypotheses derived from Janssen et al.'s (2000) model and exploring gender differences and similarities. Overall, the findings fit with Janssen et al.'s model. Whereas subliminal exposure to sexual stimuli had significant effects on automatic cognitive processes—heightened availability of sex-related thoughts while performing cognitive tasks—such exposure failed to increase conscious reports of sexual arousal, which are conceptualized by Janssen et al. as being due, at least in part, to controlled cognitive processes.

Furthermore, as expected, the effects of sexual priming were different for men and women when explicit self-reports of sexual arousal were obtained in Study 1 but not when more implicit measures of sexual arousal were used in Studies 2 and 3 (i.e., picture categorization and lexical decisions). In Study 1, men and women differed in their conscious characterizations of their reactions

to pictured opposite-sex nudes, with men saying they were sexually aroused by naked women whether or not they had received subliminal sexual priming, and women actually saying they were less aroused following subliminal sexual priming. In Studies 2 and 3, however, men and women displayed similar effects of subliminal exposure to pictures of opposite-sex nudes, suggesting that unconscious priming influences on picture-categorization and lexical decisions regarding sexual stimuli are similar in men and women.

The gender difference we observed in Study 1 is in line with previous findings indicating that men and women differ in their sex-related attitudes and beliefs (e.g., Baumeister, Catanese, & Vohs, 2001; Murnen & Stockton, 1997). It also fits with Laan and Everaerd's (1995) conclusion, based on an extensive literature review, that women's appraisal (i.e., positive or negative evaluation) of erotic stimuli explained more of the variance in consciously reported sexual arousal than the women's level of genital arousal, measured physiologically. Interestingly, however, men and women reported approximately the same level of conscious sexual arousal after being exposed to a neutral unconscious prime. So whatever the differences in attitudes and beliefs may be, they are not of a kind that affects simple conscious reactions to pictures of opposite-sex nudes.

We can think of three possible explanations for the negative effect of the subliminal sexual prime on women. One possibility is that men and women used our rating scales differently, with men exaggerating their arousal and women being more moderate in their ratings. Another possibility is that women's subliminal exposure to a naked man did arouse sexual reactions at a physiological (e.g., genital) level, but that these reactions were interpreted or labeled at the conscious level as uncomfortable. A third possibility is that sudden subliminal exposure to an image of an unfamiliar naked man registered unconsciously as a threat or a danger, which created a sense of discomfort that affected the women's ratings of the consciously visible pictures of men. The first two possibilities might be tested in future studies with genital-physiological or neuroimaging methods; the latter possibility might be tested with a lexical decision or Stroop task that contained threat-related words that might be relevant to some sexual situations such as attack, danger, assault, or rape.

If the third interpretation is correct, women should exhibit heightened activation of threat-related words in a subliminal sexual prime condition, whereas men should not. And women who were exposed to neutral primes should show less activation of threat-related words than women exposed to a "naked stranger." Similar studies have been done by social psychologists who study conscious and unconscious racism (e.g., Amodio et al., 2004). These days, it is common for American college students to be consciously liberal and "politically correct" in their reactions to minority group members. However,

less conscious and deliberate reactions, in the brain and in subtle forms of behavior, still indicate that many white students are threatened or made uncomfortable by encounters with, and pictures of, minority group members. The same kind of thing may be true for women and subliminal images of naked men.

The results of Studies 2 and 3—faster reaction times to sexual stimuli following exposure to a subliminal sexual prime on the part of both men and women—are also subject to different possible interpretations. The facilitating effects of subliminal sexual priming on cognitive processing of sex-related stimuli can be interpreted as a consequence of evolutionary adaptation: Because sex is important for survival and genetic reproduction, more attention is automatically allocated to it when sexual signals or opportunities arise. It also seems likely, however, that at a purely cognitive level, naked pictures of members of the opposite sex suggest the category “sex” and associated concepts such as genitals, orgasm, and intercourse—words used in our Study 3. Since college-aged men and women know quite a bit about all of these concepts and have seen sexual pictures, magazines, and movies and have heard and read sexual stories, both factual and fictional, both men and women are likely to have well-established associative networks related to pictures of naked college-aged men and women. The same kinds of results might therefore have been obtained if subliminal pictures of automobiles were used as primes and processing of words such as windshield, gasoline, and tires was tested. The most pressing question is whether men’s and women’s associative networks might differ in ways we did not test—specifically, in the domain of sexual threats. It would not be surprising if women had more reasons than men to be threatened by certain kinds of sexual situations, or if they had different reasons than men, who might be more threatened by performance failures such as impotence and premature ejaculation.

The alternative interpretations of the findings of both Study 1 and the combination of Studies 2 and 3 should be evaluated in future studies. In those studies it might be useful to include individual assessments of each participant’s threshold, including his or her threshold for perception following repeated exposures, rather than relying, as we did, on participants’ self-reports of inability to see the briefly exposed stimuli. (See Janssen et al., 2000, and Spiering et al., 2003, for examples.) It might also be useful to learn more about participants’ sexual experience. We did not measure the details of participants’ sexual histories, so we could not be sure that differences in experience, between genders and between individuals within genders, had no effects.

In conclusion, there is a complex interplay between automatic and controlled processes activated by sexual stimuli and affecting sexual arousal. Gender appears to play a bigger role in the controlled processes than in the automatic processes studied here, perhaps because

college-student men and women have similar semantic networks, at least regarding the fundamentals of human sexuality. We suspect that there are also likely to be gender differences in other sex-associated semantic networks, such as those representing concepts and thoughts related to sexual assault, pregnancy, and premature ejaculation, but this remains to be examined in future studies. Further research should identify more of the factors that affect the two levels of processing, automatic and controlled, and determine how they combine to explain human sexuality. Because our study participants were all young adult heterosexual Jewish college students living in Israel and having had previous sexual experience, it will also be important to see if the results generalize to other religious, ethnic, and cultural groups. Based on previous findings from Janssen et al. (2000), Spiering et al. (2003), and Schmitt and colleagues (e.g., Schmitt et al., 2004, 2005), we have no reason to doubt the cross-cultural generalizability of our main findings.

Notes

- ¹ The median age across all three studies for men was 25, and for women was 23.
- ² We also conducted the analyses including block order as a between-subjects factor, but it did not have anything close to a significant main or interactive effect, so we collapsed the data across that variable.

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GENDER DIFFERENCES IN SEXUAL RESPONSES

Appendix: Instructions for studies.

Instructions for Study 1

In the following task you will see a set of pictures, and will be asked a question regarding each one of them. Each picture will be shown on a separate trial. Each trial will begin with an “X” in the middle of the screen; please keep your eyes focused on this point. The “X” will be followed by a flash of light (grayish picture), which you should ignore. Then, after a brief pause, a target picture will appear. Following each picture, you will be asked to answer the following question: “After looking at the picture, how sexually aroused are you?” Ratings will be made on a 7-point scale ranging from “not at all aroused” (1) to “extremely aroused” (7). Please make your ratings by pressing the appropriate number on the keyboard. You might see each picture more than once. Each time, try to answer the question following the picture based on your feelings at that moment.

Instructions for Study 2

In the following task you will see a set of pictures appearing on the screen. For each picture you will have to decide whether or not it is sexual. In each trial you will first see an “X”, followed by a quick flash of light (grayish picture), which you should ignore. Following the flash you will see a target picture. You will have to decide if it’s sexual or not as fast as you can:

Press 1 if you think the picture is sexual.
Press 3 if you think the picture is non-sexual.

After pressing the number, you will see the X again.
Please respond rapidly but accurately.
First you will have a few examples.

To start, please press the space bar.

Instructions for Study 3

In the following task you will see strings of letters appear on the screen. For each string you will have to decide whether or not it is a word. In each trial you will first see an “X”, followed by a quick flash of light (grayish picture), which you should ignore. Following the flash you will see a string of letters. You will have to decide if it’s a word or not as fast as you can:

Press 1 if you think the string forms a Hebrew word.
Press 3 if you think the string does not form a Hebrew word.

After pressing the number, you will see the X again.
Please respond rapidly but accurately.
First you will have a few examples.

To start, please press the space bar.