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Sex, sexual arousal, and sexual decision making: An evolutionary perspective

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ABSTRACT

Sexual arousal is conceptualized as a motivational system that prioritizes mating and minimizes the perceived risks associated with sex. Previous studies show that when sexually aroused, individuals are more likely to endorse engaging in risky sexual behaviors. A majority of these studies examine a restricted number of sexual behaviors or do not test evolutionarily-relevant sex differences. Due to gender asymmetries in the minimum obligatory costs of parental investment, the costs of injudicious sexual decisions tend to be greater for women. As such, men and women may respond in disparate ways when sexually aroused. We extend previous research by investigating the effect of experimentally manipulated sexual arousal on sexual decision-making in men and women ($N = 140$). We found no significant difference between individuals exposed to neutral or erotic stimuli on the willingness to engage in experimental or coercive sex. Being male and having higher arousal in response to erotic stimuli, however, was associated with a greater willingness to engage in coercive sex. Results suggest that individual differences in sexual arousal following exposure to erotic stimuli may be critical for understanding sexual strategies, particularly those pertaining to sexual coercion.

1. Introduction

Engaging in sexual intercourse is requisite for reproductive success in sexually reproducing species. However, sex carries a host of proximate benefits and costs. Benefits include pleasure, stress reduction, goal attainment, and emotional commitment (Meston & Buss, 2007). Costs include the potential transmission of sexually transmitted infections (STIs), unwanted pregnancies, reputational damage, unrequited interest in a romantic relationship, negative emotions such as regret, and sexual opportunity costs (e.g., Kennair et al., 2016). Understanding motives for engaging in sex in light of these costs and benefits is critical for developing a comprehensive theory about human sexual behavior.

One mechanism that selection may have favored to facilitate sexual encounters is sexual arousal. Sexual arousal may act as a goal-oriented emotional state, shifting motivation towards sexual consummation, while simultaneously minimizing the perceived costs associated with sex (e.g., De Jong et al., 2013). From an evolutionary perspective, we might expect sex differences in sexual decision-making while sexually aroused. Because of gender asymmetries in the minimum obligatory costs of parental investment (Trivers, 1972), the costs of injudicious sexual decisions, tend to be greater for women. These costs include a higher risk of STIs (Al-Shawaf et al., 2018), reputational damage (Gallup et al., 2009), and an unpropitious or untimely pregnancy if a woman reproduces with a man of inferior quality or one unwilling to invest in her and her offspring. The greater reproductive variance of men and women has resulted in a more intense sexual selection for men, with the benefits associated with gaining additional partners outweighing the costs of having sex under some circumstances (Daly, 2001).

All else equal, it has historically been more costly for men than women to forgo sexual opportunities. This asymmetry has plausibly led to sex differences in our underlying sexual psychology, such as the male sexual over-perception bias (e.g., Bendixen, 2014) and men's greater desire for a variety of sex partners (e.g., Schmitt, 2003). Because of these sex differences in our evolved sexual psychology, sexual arousal may differentially motivate men and women. While the influence of sexual arousal may increase sexual risk-taking for both sexes, women are predicted to continue to be more discerning about risky sex than men when sexually aroused. This may be especially true for behaviors such as coercive sex where the cost discrepancies between the sexes are robust compared to behaviors that pose less obvious evolutionary costs (e.g., anal sex).

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1.1. Previous research

Researchers who have examined the relationship between sexual arousal and decision-making have done so from a diverse array of perspectives. For example, Baker and Maner (2008) tested individuals' willingness to take risks in blackjack after exposure to photos of attractive and unattractive faces. Men were more likely than women to engage in risk-taking, and this effect was stronger when exposed to attractive faces. A more recent study replicated this effect, but the study failed to find a sex difference; men and women were both more likely to engage in risky blackjack behavior when aroused (Skakoon-Sparling et al., 2016). Other researchers note decreased condom use intent when sexually aroused (e.g., Skakoon-Sparling & Cramer, 2020; Velten et al., 2016).

Ariely and Loewenstein (2006) argued that sexual arousal is an appetitive system that shifts motivations towards procurement of sex while simultaneously altering judgements and decision-making processes. They examined the relationship between sexual arousal and decision-making by assigning men to either a control condition where they simply reported their willingness to engage in a variety of different sexual activities, or to an arousal condition where they masturbated to high levels of arousal prior to reporting their willingness to engage in these behaviors. Men in the arousal condition were more likely to find a variety of less common sexual activities appealing, indicate a higher willingness to engage in date-rape like behaviors, and indicate interest in unsafe sex. This study advanced our understanding of the effects of sexual arousal as a unique, evolutionarily designed motivational system, but only from a male perspective. Because an evolutionary perspective necessarily leads to sex-differentiated predictions about engaging in risky behaviors while sexually aroused, it is critical to include both sexes when testing this association.

The overall aim of the present study was to examine the effects of sexual arousal on willingness to engage in risky sexual behaviors for men and women by inducing sexual arousal in a controlled laboratory setting. Specifically, we sought to: (1) replicate Ariely and Loewenstein's (2006) findings; (2) examine these associations in both men and women, (3) examine individual differences in arousal responses when exposed to erotic stimuli, and (4) examine a broader range of sexual behaviors than has been done in previous research.

We tested three predictions: (P1) individuals exposed to erotic stimuli will be more willing to engage in risky sexual behaviors than participants exposed to neutral stimuli; (P2) as individuals become more sexually aroused in response to erotic stimuli, willingness to engage in risky sexual behaviors will increase; and (P3) women will be less likely to engage in sexual risk-taking than men regardless of their level of sexual arousal.

2. Methods

2.1. Participants

Participants ($N = 140$; 70 men) ranging in age from 18 to 43 (M = 21.17, SD = 4.86) were recruited for a study on sexual decision-making through the university's Psychology undergraduate participant pool and from within the community. Participants were excluded if they indicated that they had never experienced penetrative intercourse, if they were pregnant, or if they did not identify as heterosexual or bisexual. Participants were mostly Caucasian (45.71%) and heterosexual (86.43%). A small subset identified as bisexual (12.86%; 9 men, 9 women) and one participant did not indicate their sexual orientation.

2.2. Procedure

Participants recruited through the University were able to sign up for the study if they met eligibility requirements. Eligibility status for community members was determined through a phone screen. Eligible participants completed a 1-hour experimental session where they were randomly assigned to either a control or experimental condition. After obtaining informed consent, participants filled out a randomized pre-film questionnaire consisting of demographics, sexual functioning indices, and current emotional affect. They then watched a 10-minute film that consisted of 4 minutes of neutral content and either: 6 minutes of nature imagery (control) or 6 minutes of a heterosexual couple engaging in oral sex and intercourse (experimental). This film has been shown to successfully induce sexual arousal in previous studies (Handy et al., 2018; Handy, Stanton, Pulverman, & Meston, 2018). After the film, participants filled out a post-film questionnaire containing our outcome variables of interest, were debriefed, and compensated for their time. All study procedures were IRB approved.

2.3. Measures

2.3.1. Demographics

We collected information on participants' age, biologically assigned sex, relationship status, relationship length, mating orientation, religiosity, political orientation, and sexual orientation (see Supplementary Materials).

2.3.2. Willingness to engage in risky sexual behaviors

Participants completed 5 modified questions from Ariely and Loewenstein (2006)'s study and 13 questions based on trending topics in pornography as indexed by Pornhub's, 2017 Year in Review (Pornhub INSIGHTS, 2017). As per Ariely and Loewenstein (2006)'s methodology, we presented all risk-taking questions randomly directly after the film and asked participants to indicate the likelihood that they would be willing to participate in each behavior on a scale of 0 (not all willing) to 100 (extremely willing).

2.3.3. Mean level of subjective sexual arousal

Subjective sexual arousal was measured continuously throughout the presentation of the films using an arousometer. The arousometer is a computer mouse mounted onto a wooden trackpad that participants move continuously throughout a film using a scale from 0 (no sexual arousal) to 7 (maximum sexual arousal) as they feel their mental sexual arousal changing (Rellini et al., 2005). We calculated a mean level of subjective sexual arousal throughout the 6 minutes of film content to use as an independent variable in subsequent analyses.

3. Results

3.1. Sexual arousal manipulation

As a validity check, we compared the mean level of subjective sexual arousal for participants exposed to erotic stimuli (e.g., experimental condition) to the mean level of subjective sexual arousal for participants exposed to neutral stimuli (e.g., control condition). Participants exposed to erotic stimuli ($M = 3.64$; $SD = 1.69$) were significantly more sexually aroused than participants exposed to neutral stimuli ($M = 0.82$; $SD = 1.20$), confirming that our manipulation of sexual arousal was effective ($t(124.44) = 11.37$, $p < .001$; Cohen's $d = 1.92$).

3.2. Factor analyses

All analyses were conducted in RStudio (RStudio Team, 2020). We conducted an exploratory factor analysis specifying promax rotation with minimum residuals to see how the 18 questions grouped together for all participants using the fa function of the pysch package (Revelle, 2020). By doing this, we sought to measure willingness to engage in risky sexual behaviors across the questions without employing a battery of statistical tests and potentially losing power.

Both parallel analysis and a scree plot indicated a two-factor solution best fit the data. One-, two-, and three-factors solutions were tested. A

two-factor solution proved optimal and made the most conceptual sense, accounting for 34.70% of the variance after retaining items that loaded at 0.35 or higher on one of the two factors (see Table 1). We used 0.35 as a cutoff threshold to ensure that the items were consistent within each factor and to reduce the items down to the most theoretically important items. We removed items that loaded at 0.30 or higher on more than one factor, with the exception of one item (*Would you take a date to a fancy restaurant to increase your chance of having sex with her/him*?) which loaded at 0.52 and 0.34 on the first and second factor, respectively. We chose to retain this item for comparative purposes as it was used as a dependent variable in Ariely and Loewenstein's (2006) study. We eliminated one item that was factor inconsistent (*Would you consider having sex with a particularly mature 15-year-old if he/she were coming on to you*?). We labeled the factors according to the content of the items that loaded on them: coercive (α = 0.66) and experimental (α = 0.62) sex.

3.3. Willingness to engage in coercive or experimental sex for the whole sample

Prior to analyses, we coded biological sex as a factor (sex going forward), and created separate factor scores for coercive and experimental sex by taking the mean of the items that composed the separate factors. We next conducted a series of ordinary least square regressions (OLS) to test the interaction and main effects of being exposed to erotic stimuli and sex on willingness to engage in coercive sex and experimental sex for all participants.

Results revealed no significant interaction between being exposed to erotic stimuli and sex on willingness to engage in coercive sex ($\beta = -0.53$, $p = .907$). When removing the interaction, there was a significant main effect of sex ($\beta = -9.09$, $p < .001$; Cohen's $d = 0.68$), such that women were less willing than men to participate in coercive sex. There was no main effect of being exposed to erotic stimuli ($\beta = -2.73$, $p = .229$; Cohen's $d = 0.19$) on willingness to engage in coercive sex. Results were robust to case resampling bootstrapping (see Table 2 and Supplemental Materials, Fig. 1).

There was no significant interaction between being exposed to erotic stimuli and sex on willingness to engage in experimental sex ($\beta = 5.54$, $p = .430$). There was, however, a significant main effect of sex ($\beta = -10.05$, $p = .00465$; Cohen's $d = 0.49$), such that women were less willing than men to participate in experimental sex. There was no significant main effect of being exposed to erotic stimuli ($\beta = 1.36$, $p = .697$; Cohen's $d = 0.06$) on willingness to engage in experimental sex. Results were robust to case resampling bootstrapping (see Table 3 and Supplemental Materials, Fig. 2).

Table 1
Factors of sexual risk-taking.

Items	Coercive sex	Experimental sex
Would you encourage your date to drink to increase the chance that she/he would have sex with you?	0.83	
Would you tell a woman/man that you loved her/him to increase the chance that she/he would have sex with you?	0.67	
Would you take a date to a fancy restaurant to increase your chance of having sex with her/him?	0.52	
Would you keep trying to have sex after your date says no?	0.49	
Would you slip a woman/man a drug to increase the chance that she/he would have sex with you?	0.46	
Would you consider having sex with someone who is transgender just out of curiosity?		0.65
Would you consider letting your sexual partner urinate on you during sex?		0.57
Would you consider participating in group (i.e., an orgy) sex?		0.50
Would you consider having anal sex?		0.44
Would you consider having sex while on your period/with someone who was on their period?		0.42

Note. The final factor solution indicated acceptable model fit (TLI = 0.952; RMSEA = 0.042; $\chi^2(26, N = 140) = 32.40$, $p = .179$; see Marsh et al., 2004).

Table 2
Regression results of willingness to engage in coercive sex for all participants ($N = 140$).

	Unstandardized coefficients	*p-Value*	OLS confidence intervals (CIs)	Bootstrapped CIs
(Intercept)	18.70	**<.001**	[14.83, 22.57]	[14.36, 23.42]
Condition	−2.73	.229	[−7.20, 1.74]	[−7.23, 1.64]
Sex [being female]	−9.09	**<.001**	[−13.56, −4.63]	[−13.51, −4.79]
Condition * sex	−0.53	.907	[−9.50, 8.44]	[−9.54, 8.34]

Note. R^2/R^2 adjusted = 0.114/0.101. Reported main effects are after removing the interaction.

3.4. Individual differences in arousal responses

A series of analyses was conducted to investigate individual differences in arousal responses to erotic stimuli for participants in the experimental condition. We examined this for the experimental group only because the mean level of subjective sexual arousal in the control group is meaningless as they were not exposed to erotic stimuli. Participants in the experimental condition ($n = 70$; 35 men) ranged in age from 18 to 38 (M = 21.43, SD = 4.57), were mostly Caucasian (37.14%), and heterosexual (82.86%). The mean level of arousal for men exposed to erotic stimuli ($M = 3.97$; $SD = 1.66$) was higher than that of women exposed to erotic stimuli ($M = 3.32$; $SD = 1.68$), although not significantly so ($t(67.99) = 1.62$, $p = .111$; Cohen's $d = 0.17$).

OLS regressions revealed no significant interaction between sex and arousal ($\beta = -2.17$, $p = .192$) on willingness to engage in coercive sex. There was, however, a main effect of arousal ($\beta = 2.73$, $p = .00156$) such that being more sexually aroused was associated with higher willingness to engage in coercive sex. There was also a main effect of sex ($\beta = -7.59$, $p = .00811$; Cohen's $d = 0.77$) such that being female decreased an individual's willingness to engage in coercive sex. Results were robust to case resampling bootstrapping (see Table 4 and Supplementary Materials, Fig. 3).

There was no significant interaction between sex and arousal ($\beta = -0.25$, $p = .937$), no main effect of arousal ($\beta = 1.09$, $p = .494$) and no main effect of sex ($\beta = -6.58$, $p = .220$; Cohen's $d = 0.33$) on willingness to engage in experimental sex. Results were robust to case resampling bootstrapping (see Table 5 and Supplementary Materials, Fig. 4).

A series of exploratory Pearson correlations was conducted between the mean level of subjective sexual arousal and a variety of individual differences variables for men and women exposed to erotic stimuli. Results revealed weak to moderate negative correlations between religiosity and interest in long-term mating with mean levels of arousal for

Table 3
Regression results of willingness to engage in experimental sex for all participants ($N = 140$).

	Unstandardized coefficients	*p-Value*	OLS CIs	Bootstrapped CIs
(Intercept)	38.72	<.001	[32.74, 44.70]	[38.72, 44.48]
Condition	1.36	.697	[−5.54, 8.27]	[1.36, 8.30]
Sex [being female]	−10.05	.00465	[−16.95, −3.14]	[−10.05, −3.22]
Condition * sex	5.54	.430	[−8.29, 19.37]	[5.54, 18.75]

Note. R^2/R^2 adjusted = 0.058/0.044.

Table 4
Regression results of willingness to engage in coercive sex for the experimental condition ($n = 70$; 35 men).

	Unstandardized coefficients	*p-Value*	OLS CIs	Bootstrapped CIs
(Intercept)	5.27	.171	[−2.34, 12.88]	[−0.43, 11.90]
Mean level of arousal	2.73	.00156	[1.08, 4.38]	[1.25, 4.25]
Sex [being female]	−7.59	.00811	[−13.15, −2.04]	[−12.98, −2.48]
Mean level of arousal * sex [being female]	−2.17	.192	[−5.46, 1.12]	[−5.08, 0.83]

Note. R^2/R^2 adjusted = 0.252/0.230.

Table 5
Regression results of willingness to engage in experimental sex for the experimental condition ($n = 70$; 35 men).

	Unstandardized coefficients	*p-Value*	OLS CIs	Bootstrapped CIs
(Intercept)	34.38	<.001	[19.85, 48.91]	[19.49, 47.67]
Mean level of arousal	1.09	.494	[−2.07, 4.24]	[−2.00, 4.42]
Sex [being female]	−6.58	.220	[−17.19, 4.03]	[−16.54, 3.68]
Mean level of arousal * sex [being female]	−0.25	.937	[−6.61, 6.11]	[−7.29, 5.82]

Note. R^2/R^2 adjusted = 0.035/0.006.

men, such that higher levels of religiosity ($r = -0.24$; $p = .168$) and more interest in long-term mating ($r = -0.31$; $p = .073$) were associated with *lower* levels of mean subjective sexual arousal. For women, there were weak to moderate correlations between interest in short-term and long-term mating and mean levels of arousal, such that more short-term oriented individuals had lower levels of arousal ($r = -0.12$; $p = .502$), and more long-term oriented individuals had higher levels of mean sexual arousal ($r = 0.40$; $p = .018$; see Supplementary Materials, Table 6).

4. Discussion

This study investigated the effect of experimentally manipulated sexual arousal on the willingness to engage in two types of risky sexual behaviors in men and women. We predicted that individuals exposed to erotic stimuli would be more willing to engage in risky sexual behaviors than participants exposed to neutral stimuli; as individuals became more sexually aroused in response to erotic stimuli, willingness to engage in risky sexual behaviors would increase; and women would be less likely to engage in sexual risk-taking than men regardless of their level of sexual arousal. We found mixed support for these predictions.

Being exposed to erotic or neutral stimuli had no impact on willingness to engage in either coercive or experimental sex. This contradicts previous research and highlights the ambiguity of this association. It is possible that there is no effect of exposure to erotic stimuli on sexual risk-taking, that the current study was too underpowered to detect this effect, or that sexual arousal needs to be activated to high levels to produce the predicted decision-making effect. Although our arousal manipulation was effective, the mean level of sexual arousal for participants exposed to erotic stimuli in our study was around the midpoint of the scale—lower than the reported levels in some related research (e.g., Ariely and Loewenstein, 2006).

As individuals became more sexually aroused in response to erotic stimuli, willingness to engage in coercive sexual behaviors increased. These findings conceptually replicate those of Ariely and Loewenstein (2006) who also found that sexual arousal increased men's willingness to engage in coercive sexual behavior. Willingness to engage in experimental sexual behaviors, however, was not altered as arousal increased. It is possible that the behaviors subsumed by the experimental sex factor in this study have become normalized to such a degree that they are not considered risky, and as a result may not require heightened arousal to elicit sexual interest. Pornhub's, 2019 year in review provides support for this possibility, reporting that anal sex and threesomes—both subsumed by our experimental sex factor—were among some of the top searched terms in 2019 (Pornhub INSIGHTS, 2019).

We found that men were more willing than women to engage in sexually coercive behavior. This sex difference existed when controlling for condition and when investigating men who were exposed to erotic stimuli separately. This overall main effect of sex provides evidence that men in this sample were significantly more willing to engage in coercive sexual behaviors than women, independent of their level of sexual arousal. This supports the hypothesis derived from evolutionary metatheory that, on average, women's sexual psychology is highly discriminative across most mating contexts (Daly, 2001).

The sex differences in willingness to engage in coercive sexual behaviors uncovered in this study could, however, be attributable to factors other than women's greater levels of sexual discernment. If men are more willing than women to engage in sex, on average, then women have more sexual opportunities and thus do not need to use coercive sexual strategies. Importantly, these results do not imply that men have specific evolved adaptations to engage in sexually coercive behaviors. Rather, sexual coercion appears to be a byproduct of men's higher levels of sexual desire (Buss & Schmitt, 1993) combined with their willingness to use physical force in a variety of contexts (e.g., hunting) to achieve instrumental ends (Buss, in press).

In contrast, we found mixed support for sex differences in willingness to engage in experimental sex. When controlling for condition, men reported significantly higher levels of willingness to engage in experimental sex than women. Conversely, when examining sex differences for participants exposed to erotic stimuli, there was no significant sex difference in willingness to engage in experimental sexual behaviors. Possibly, men and women, on average, are equally likely to engage in the behaviors subsumed by our experimental sex factor independent of levels of sexual arousal. Alternatively, this lack of sex difference may be attributable to political orientation. Our sample was derived from a notably liberal university and community. In fact, 92.14% of our sample indicated being moderately to extremely politically liberal. Previous research suggests more liberal individuals are less likely to find a variety of sexual behaviors disgusting (e.g., Crosby et al., 2020), and are more likely to engage in a wider variety of sexual behaviors (e.g., Hatemi et al., 2017). Lastly, while evolutionarily it has been more costly for men to forgo sexual opportunities, the behaviors subsumed by the experimental sex factor—with the exception of group sex—may pose similar biological, social, or psychological costs for the sexes.

With regard to our exploratory analyses of individual differences in arousal responses to erotic stimuli, while speculative, it is interesting that women—but not men—who were more interested in long-term mating had significantly higher levels of sexual arousal. This finding may relate to previous work suggesting that women's sexual arousal is intrinsically tied to romantic partnerships—significantly more so than men's (e.g., Freihart et al., 2020). These findings may also relate to the well-established sex differences in men's and women's' sexual psychology (Buss & Schmitt, 1993). Of course, this result may also be spurious, as it was the only significant correlation out of several and we employed no statistical corrections for multiple testing.

Our findings are limited by the fact that these questions are hypothetical. We cannot be certain that participants' answers are representative of how they might act during actual spontaneous sexual encounters. Also, although our sample size was nearly twice that of previous research of this nature (Ariely & Loewenstein, 2006), we used a between-subjects design and, as such, it may be underpowered. Our

sample size was determined by time, funding, and the difficulty of running participants through an in-lab study one at a time—constraints common in most psychological research (Lakens, 2021). However, because research investigating sexual arousal's impact on the willingness to engage in an extensive list of sexual behaviors for men and women is lacking, the results of this study provide insight into the size of these effects. We urge readers to interpret the *p*-values reported in this study with caution and to instead focus on each test's effect size which will inform future research.

In conclusion, the current study builds upon previous research investigating the link between sexual arousal and sexual risk-taking in men and women. We found that being male and having higher reported arousal in response to erotic stimuli was associated with a greater willingness to engage in coercive sex. We did not find support for the previously reported effect of exposure to erotic stimuli on willingness to engage in risky sexual behaviors. Together, our results suggest that rather than induced sexual arousal driving an increased willingness to engage in risky sexual behaviors, individual differences in sexual arousal responses following exposure to erotic stimuli may be critical for men's and women's sexual strategies, particularly those pertaining to sexually coercive behavior.

CRediT authorship contribution statement

Courtney L. Crosby: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Software, Visualization, Writing – original draft, Writing – review & editing. **David M. Buss:** Conceptualization, Funding acquisition, Methodology, Resources, Supervision, Writing – original draft, Writing – review & editing. **Lawrence K. Cormack:** Formal analysis, Software, Validation. **Cindy M. Meston:** Conceptualization, Funding acquisition, Methodology, Resources, Supervision, Writing – original draft, Writing – review & editing.

Declaration of competing interest

None.

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Appendix A. Supplementary Materials

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