



Sexual Arousal Discounting: Devaluing Condom-Protected Sex as a Function of Reduced Arousal

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Abstract

Sexual discounting is a growing area of research aimed at identifying factors that reduce people's reported willingness to have safe sex. One commonly reported reason for condom non-use is that a condom reduces sexual arousal. However, researchers have yet to isolate the specific role of sexual arousal using a sexual discounting framework. We extended past research by measuring how sexual arousal reduced people's willingness to have condom-protected sex ("sexual arousal discounting": SAD). College students ($n = 379$; 67.5% females) selected partners they most wanted and least wanted to have sex with and were randomized to one of two groups. In one group, participants rated their willingness to have sex with a condom if their own arousal decreased (from 100 to 10%) from condom use. The other group completed the same task except their partner's arousal decreased from condom use instead of their own. We observed a three-way interaction between arousal levels, most versus least desirable partners, and self versus partner groups. Participants' willingness to have condom-protected sex systematically reduced as a function of sexual arousal. This was observed more with the most (vs. least) desirable partner and in the self-arousal (vs. partner-arousal) group but only when the partner was their least desirable. Men (vs. women) displayed more arousal discounting but only with the most desirable partner. Finally, higher arousal discounting was associated with lower safe-sex self-efficacy and higher reported frequency of unprotected sex in the past 3 months. This study demonstrates how reduced sexual arousal from condom use can be measured as a factor influencing sexual risk-taking.

Keywords Discounting · Sexual arousal · Condom · Attractiveness · STI · HIV/AIDS

Introduction

In behavioral economics, discounting broadly refers to a reduction in the subjective value of a commodity or experience as some dimension of that commodity or experience changes (Rachlin, 2006). Sexual discounting, a relatively new area in the study of sexual risk-taking, examines how changing some dimension of a sexual experience influences participants' reported likelihood or willingness to have safe

sex. Two commonly studied dimensions are (1) delay to condom access (i.e., sexual delay discounting or SDD) and (2) probability of safe sex or health consequences of unsafe sex (i.e., sexual probability discounting or SPD). For sexual delay discounting, the common finding is that the likelihood of having condom-protected sex systematically decreases as a function of increased delay to condom availability (Johnson & Bruner, 2012, 2013; Wongsomboon & Robles, 2017). For sexual probability discounting, the common finding is that the likelihood of having condom-protected sex systematically decreases as a function of decreased probability of contracting a sexually transmitted infection (STI) through unprotected sex (or decreased probability of sex with a condom in one study; Berry, Johnson, Collado, & Loya, 2019; Johnson, Johnson, Herrmann, & Sweeney, 2015b; Wongsomboon & Robles, 2017).

Research has shown that sexual discounting is a robust measure of sexual risk-taking as the above patterns of choice have been replicated in several populations, including adolescents, young adults, men who have sex with

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men, heavy drinkers, cigarette smokers, and drug users (Dariotis & Johnson, 2015; Hahn et al., 2019; Herrmann, Hand, Johnson, Badger, & Heil, 2014; Herrmann, Johnson, & Johnson, 2015; Johnson, Sweeney, Herrmann, & Johnson, 2016; Koffarnus et al., 2015; Lemley, Fleming, & Jarmolowicz, 2017; Lemley, Jarmolowicz, Parkhurst, & Celio, 2018; Thamocharan, Hahn, & Fields, 2017). Moreover, greater sexual discounting (e.g., greater reduction in willingness to use a condom with increased delay to condom availability) is associated with greater reported past sexual risk behavior (Collado, Johnson, Loya, Johnson, & Yi, 2017; Herrmann et al., 2015; Johnson & Bruner, 2012; Lemley et al., 2017, 2018).

Given the range of possible arousal states (e.g., fully or partially aroused) resulting from condom use, people's willingness to use a condom might also be influenced by the degree that condoms decrease sexual arousal. Many people (~40–70% of some samples) have reported that condom use reduces their overall sexual arousal and pleasure (Crosby, Milhausen, Yarber, Sanders, & Graham, 2008; Higgins, Hoffman, Graham, & Sanders, 2008; Strong, Bancroft, Carnes, Davis, & Kennedy, 2005; Widdice, Cornell, Liang, & Halpern-Felsher, 2006). Further, reduced pleasure from condom use occurs in both men and women and has been cited as the main reason they do not use condoms or use condoms irregularly (Fennell, 2014; Graham, Crosby, Milhausen, Sanders, & Yarber, 2011; Higgins, Tanner, & Janssen, 2009; Higgins & Wang, 2015). Researchers have examined the association between reduced arousal and sexual risk-taking (Skakoon-Sparling, Cramer, & Shuper, 2016; Strong et al., 2005), and one study examined whether sexual arousal influenced delay discounting of monetary rewards (Wray, Simons, & Maisto, 2015). However, to our knowledge, no study has used a sexual discounting framework to examine how willingness to use a condom decreases due to reduced sexual arousal.

The purpose of this study, therefore, was to examine how reducing sexual arousal from condom use decreased willingness to have condom-protected sex. Existing discounting literature suggests that domain-specific measures (e.g., delay discounting for sexual activity) are more sensitive to measuring differences in the behavior of interest compared to domain general measures (e.g., delay discounting for money; Jarmolowicz et al., 2014; Lawyer & Schoepflin, 2013; Lemley et al., 2018; Mahoney & Lawyer, 2018). Thus, to measure how sexual arousal influences condom use, sexual arousal should be directly manipulated as the independent variable. In this study, we defined sexual arousal discounting as a systematic decrease in willingness to use a condom as a function of reduced sexual arousal.

More specifically, we had three primary aims. First, we aimed to measure how systematic changes in sexual arousal influenced people's reported willingness to have sex with a

condom. We hypothesized that people would display sexual arousal discounting when a condom decreased sexual arousal.

Second, we aimed to examine the covariates associated with sexual arousal discounting. One likely covariate is partner attractiveness (Eleftheriou, Bullock, Graham, Skakoon-Sparling, & Ingham, 2019; Eleftheriou, Bullock, Graham, Stone, & Ingham, 2016; Sarno & Mohr, 2019). Past sexual discounting studies found that people were less willing to wait for access to a condom with the most (vs. least) desirable partner (Johnson & Bruner, 2012, 2013; Wongsomboon & Robles 2017). Therefore, in this study, we hypothesized that people would be less willing to use a condom with the most (vs. least) desirable partner when the condom reduced sexual arousal.

A second likely covariate is whose arousal decreases via condom use. Most studies that have examined the effect of sexual arousal on sexual risk-taking focused on the participant's own arousal (e.g., Higgins et al., 2009), and thus the effect of their partner's arousal on condom use remained unclear. In this study, we manipulated whose arousal was reduced through condom use across groups. Because this is the first study to examine the effect of the arousal target on sexual arousal discounting, we did not have an *a priori* hypothesis regarding potential group differences.

A third possible covariate is participant sex. Men (vs. women) are more likely to take sexual risks (Skakoon-Sparling et al., 2016; Skakoon-Sparling & Cramer 2019) and to report reduced pleasure from condom use (Higgins & Wang, 2015). However, little is known about sex differences in reduced condom use as a function of sexual arousal. Past studies showed that men were less likely to wait for access to a condom and were less influenced by the probability of contracting an STI compared to women (Berry et al., 2019; Johnson & Bruner, 2013). However, researchers in one study found no significant sex difference in willingness to wait for a condom (Dariotis & Johnson, 2015), and researchers in another study found that condom-related arousal was more highly associated with unprotected sex among women (vs. men; Higgins et al., 2009). In total, the relationship between sex, arousal levels, and condom use is unclear and, therefore, we did not have an *a priori* hypothesis regarding sex differences in sexual arousal discounting.

Because the sexual arousal discounting (SAD) task was first developed for this study, the final aim was to test whether performance on the SAD task predicted scores on other criterion measures relating to sexual risk-taking, such as safe-sex self-efficacy and past condom-use behavior (Ahmed et al., 2001; Asante, Osafo, & Doku, 2016; Gallo et al., 2007; Nesoff, Dunkle, & Lang, 2016). In this study, we hypothesized that higher rates of arousal discounting would be associated with lower safe-sex self-efficacy and higher frequency of past unprotected casual sex (i.e., sex outside a committed

exclusive relationship). The study specifically focused on past condom use in casual sex because condomless sex with uncommitted (vs. committed) partners may put one at higher risk for STIs (Lu et al., 2009; Lyons, 2017).

In total, the present study had three confirmatory hypotheses. In addition to the hypotheses, we also tested three research questions for exploratory purposes.

Hypotheses

H1 Willingness to have condom-protected sex would decrease as sexual arousal decreased from condom use.

H2 Participants would discount safe sex more with their most desirable partner compared to their least desirable partner.

H3 Higher arousal discounting would be associated with lower safe-sex self-efficacy (H3a) and higher frequency of unprotected casual sex (H3b).

Exploratory Research Questions

R1 Would there be difference in arousal discounting between the self-arousal group and the partner-arousal group?

R2 Would there be interactions among arousal level, partner desirability (most vs. least), and arousal target (self vs. partner)?

R3 Would there be difference in arousal discounting between men and women?

Method

Participants

Undergraduate students ($n = 390$) from an introductory psychology class at a large public university were recruited via the psychology department's research participation system. All students received a research credit for participation. Inclusion criteria included (1) being 18–40 years old, (2) having an interest in male–female or male–male sexual intercourse (i.e., women who were sexually attracted only to women were not eligible), and (3) having no problem imagining themselves having sex with a person they first met. Participants read the inclusion criteria before signing up to participate in the study (no pre-screening). Similar to other sexual discounting studies (e.g., Berry et al., 2019), women who would have sex only with women were excluded because the present study focused solely on male condom use.

Participants began with a sexual partner selection process (described below). Eight participants selected less than two pictures were removed from analyses. Three participants were removed because they did not complete all tasks. Thus, the final sample included 379 participants aged 18–40 ($M = 18.97$, $SD = 2.06$), and 276 (67.5%) self-identified as female. The female sample included 94.1% heterosexual, 5.5% bisexual, and 0.4% other (none were homosexual). The male sample included 88.6% heterosexual, 6.5% homosexual, and 4.9% bisexual. The total sample included 56.8% European White, 18.3% Hispanic/Latinx, 13.5% Asian, 8% Black, 1.3% Middle Eastern, and 2.1% other. Regarding relationship status and sexual experience, 36% reported currently being in a relationship and 67% reported having had experience in sexual intercourse.

Procedure and Measures

The study was entirely online and could be completed at any location. All procedures were carried out in the Qualtrics survey platform. Participants were asked to imagine being single and available if they were currently in a relationship. The verbatim instructions shown in the partner selection and sexual arousal discounting procedures can be found in the supplemental material (<https://osf.io/xe8u7/>).

Partner Selection

Before the main experiment, participants chose hypothetical sexual partners from a pool of pictures. Female participants saw 20 pictures of only males. Male participants sexually attracted to women saw 20 pictures of females. Male participants sexually attracted to men saw 20 pictures of males. Male participants sexually attracted to all sexes saw 40 pictures—20 males and 20 females.

Participants began by excluding anyone with whom they would never want to have sex under any circumstance. Next, they confirmed that the remaining, non-excluded pictures depicted people they might have sex with in at least some situations (e.g., when drinking alcohol). Participants could exclude as many pictures as they wanted (or even none). However, unknown to the participants, the study would end if they did not include two or more potential sexual partners.

Finally, from the remaining pictures, participants selected one person they most wanted to have sex with (the most desirable partner) and one person they least wanted to have sex with (the least desirable partner). The two selected pictures became their hypothetical sexual partners for the SAD task. For a manipulation check, participants rated the sexual attractiveness of their selected partners on a scale of 0–10 (higher scores indicated more attractiveness). As expected, the most desirable partner was rated as more sexually attractive ($M = 9.04$; $SD = 1.18$) than the least desirable partner

($M = 4.88$; $SD = 1.98$; $t[373] = 39.53$, $p < .001$). In addition to attractiveness, participants also rated the likelihood that the partners had an STI on a scale of 0–10 (higher scores indicated more likelihood of having an STI). We found no significant difference in perceived likelihood of having an STI between the two partners ($M = 5.29$, $SD = 2.10$ for the most desirable; $M = 5.25$, $SD = 2.22$ for the least desirable; $t[375] = 0.39$, $p = .700$). Thus, the partners only differed in perceived attractiveness but not perceived STI risk.

The Sexual Arousal Discounting Task

Participants were asked to imagine they met the selected partner and were in the mood for sex. They also imagined they (or their partner) were effectively using birth control (e.g., IUD) and there was very low chance of pregnancy.

Participants were randomly assigned into one of two groups—self-arousal or partner-arousal. For the self-arousal group, participants rated their willingness to use a condom when condom use would decrease their own arousal. For the partner-arousal group, condom use would decrease their partner's arousal instead. Participants were told that sexual arousal was defined as the “physiological responses that occur in the body and mind such as nipple hardening, erection of penis or clitoris, and vaginal lubrication.”

Participants completed the full task once with the most desirable partner and once with the least desirable partner, and the order was randomized. On each trial, participants rated their willingness to have condom-protected sex with each partner. A visual analog scale (VAS) ranged from 0 to 100 where 0 was “I would definitely have sex without a condom” and 100 was “I would definitely have sex with a condom.”

For each partner, the first trial was the fully aroused trial where their (or their partner's) sexual arousal was 100% with or without a condom. After the first trial, participants were then informed that, for the next tasks, using condoms would decrease their (or their partner's) level of sexual arousal. The instruction also emphasized that they (or their partner) could still have sexual intercourse regardless of levels of sexual arousal, even though their (or their partner's) levels of sexual arousal might have an impact on sexual pleasure and/or quality of sex. To control for individual differences in past experience with condom use, participants in the self-arousal group were also asked to imagine that their sexual arousal in this sexual encounter was affected by condom use regardless of their real experience with condoms in the past.

Participants repeated the above question five times for increasingly reduced sexual arousal. The percentage of sexual arousal from condom use decreased in a descending order as follows: 90%, 75%, 50%, 25%, and 10%. In all trials, arousal remained at 100% (fully aroused) if they chose to have sex without a condom. In other words, for each trial, participants

chose between condom-protected sex with partial arousal (e.g., 50%) and condomless sex with full arousal (100%).

In this study, we modified the traditional sexual discounting measure by adding an “opt-out” option. Past research on sexual discounting traditionally asked participants to choose between having sex with a condom or having sex without a condom (e.g., Johnson & Bruner, 2012). In everyday contexts, however, most people also have the option to abstain from having sex altogether. Therefore, to increase the ecological validity of our task with real sexual choices, participants were provided the option to opt out of having sex with or without a condom.

For each trial, participants could select a box to indicate they did not want to have sex without making a response on the VAS scale. If the participants selected the opt-out option at a particular arousal level, the remaining arousal levels were not shown to the participants. For example, if one opted out from having sex at the 50% arousal, they would not see the 25% and 10% arousal trials. The rationale was that people would be unlikely to have sex at lower arousal levels if they already indicated they would not have sex when arousal was at a higher level. Detailed analyses and results regarding the opt-out option can be found in the supplemental material.

Safe-Sex Self-Efficacy and Past Condom-Use Behavior

We assessed safe-sex self-efficacy in two ways. One was self-efficacy for condom use, and the other was self-efficacy for negotiating safer sex with a partner(s). The Self-Efficacy for Condom Use Scale (Mausbach, Semple, Strathdee, Zians, & Patterson, 2007) is a 9-item measure asking participants to rate their confidence in using a condom on a 4-point scale (1 = *strongly disagree* and 4 = *strongly agree*). Example items were “I can use a condom properly,” “I can use a condom every time I have penetrative sex,” and “I can use a condom in any situation.” Responses were summed to create an overall self-efficacy score ($M = 28.91$, $SD = 4.68$) with higher scores indicating higher self-efficacy ($\alpha = .89$).

The Self-Efficacy for Negotiating Safer Sex Scale (Mausbach et al., 2007) is a 7-item measure asking participants to rate their confidence in negotiating condom use with their sexual partner(s) on a 4-point scale (1 = *strongly disagree* and 4 = *strongly agree*). Example items were “I can negotiate condom use with any partner,” “I could get my partner to use a condom if he/she doesn't want to,” and “I can convince my partner(s) that condoms are erotic.” Responses were summed to create an overall self-efficacy score ($M = 20.92$, $SD = 3.10$), with higher scores indicating higher self-efficacy ($\alpha = .78$).

For past condom-use behavior, participants indicated the number of times they had condomless sex with casual sex partners (i.e., partners not in a committed, exclusive relationship with them) in the past 3 months. Participants reported

this number by writing down any whole integer or “0” if they always used a condom when having casual sex. Participants first reported the total number of times they had casual sexual encounters in the past 3 months. Participants reporting at least one casual sexual encounter ($n = 107$) indicated the frequency of unprotected sex with casual sex partner(s) in the past 3 months.

The numbers of casual sexual encounters ($M = 2.15$, $SD = 5.01$) and unprotected sex ($M = 2.30$, $SD = 3.88$) were positively skewed. Therefore, both were natural-log-transformed before the analyses ($M = 0.63$, $SD = 0.88$ for number of casual sex; $M = 0.79$, $SD = 0.83$ for frequency of unprotected sex after log-transformation).

Data Analysis

We used multilevel modeling (MLM) and area under the curve (AUC) analyses to understand sexual arousal discounting. MLM tested how sexual arousal (and other covariates) affected interindividual and intraindividual differences in reported willingness to use a condom. AUC provided an individual measure of the degree to which each participant discounted condom-protected sex as a function of sexual arousal. In other words, AUC helped quantify discounting (lower AUC indicates higher discounting) and allowed us to answer questions regarding discounting (e.g., group differences in sexual arousal discounting).

One of the benefits of MLM is that it does not require an independence assumption because it can account for variances in Level 1 and Level 2 units (Peugh, 2010). The SAD task is a repeated measure with two units—six levels of sexual arousal (a Level 1 unit) are nested within persons (a Level 2 unit). We tested both fixed and random effects of arousal. The fixed effect indicates whether participants, on average, were less willing to report they would use a condom when arousal decreases. The random effect of arousal indicates whether the relationship between arousal and reported willingness to use a condom (i.e., the slope) varied between people. Additionally, because MLM uses maximum likelihood to handle missing data, the analysis can retain all participants despite incomplete responses due to opting out or nonsystematic data (Young, 2018).

We transformed the raw VAS ratings using Blom formula (Altman, 1990) because they were negatively skewed. MLM was conducted using full maximum likelihood and variance components. The first model was an unconditional model in which only the outcome variable (willingness to use a condom) was entered. With no predictor in the model, the within-person variance (residual) was significantly different from zero ($p < .001$). This suggests that proceeding with the MLM analysis was appropriate.

The main analyses included three models. In Model 1, only arousal level was entered. In the next model (Model 2),

the two covariates (partner desirability and arousal target) were added. In the last model (Model 3), the two-way and three-way interactions were added, including (1) arousal level \times partner desirability, (2) arousal level \times arousal target, (3) partner desirability \times arousal target, and (4) arousal level \times partner desirability \times arousal target. Fit statistics of each model are shown in Table 1.

AUC refers to the area under the discounting curve and was used to assess the overall extent to which changing arousal level reduced participants' reported willingness to use a condom. We calculated AUC using the method by Myerson, Green, and Warusawithrana (2001). The raw willingness ratings from the VAS were normalized for each participant by dividing the reported willingness to use a condom at each arousal level by the reported willingness to use a condom when arousal was 100%.¹ This data transformation results in normalized AUC values ranging from 0.0 to 1.0. An AUC of 1.0 indicates that arousal level did not influence willingness to use a condom. As AUC values approach 0.0, they indicate that arousal level had a greater influence on reported willingness to use a condom.

Some participants reported zero willingness to use a condom at the 100% arousal level ($n = 14$ in the most-desirable-partner condition and $n = 1$ in the least-desirable-partner condition). These participants were removed from the AUC analyses because their data were undefined after normalization. For analyzing AUC at the group level, we also excluded participants who did not complete all six arousal questions because they opted out ($n = 83$ or 22% of the sample). Of these, one participant opted out only in the most-desirable-partner condition, 46 participants opted out only in the least-desirable-partner condition, and 36 participants opted out in both conditions.

Data were flagged as potentially nonsystematic if willingness to use a condom increased by more than 20% of the preceding (higher) arousal level (Johnson & Bickel, 2008). Data were also flagged as potentially nonsystematic if willingness to use a condom increased by more than 10% from the highest arousal percentage to the lowest arousal percentage (Johnson, Herrmann, & Johnson, 2015a). Of the datasets flagged as potentially nonsystematic, 14 (4% of the sample) from the most-desirable-partner condition and 9 (2% of the sample) from the least-desirable-partner condition had two or more points that met nonsystematic criteria and were removed from the AUC analyses.

We conducted a Wilcoxon signed-rank test to compare the difference between AUC in the most-desirable-partner

¹ In some cases (10% and 6% of the sample in the most-desirable-partner and least-desirable-partner conditions, respectively), the willingness rating in the 100% trial was not the highest, which resulted in AUC higher than 1.0. Thus, to keep AUC at or below 1.0, we divided all ratings by the highest rating found in all trials instead.

Table 1 Multilevel modeling statistics

	Unconditional	Model 1	Model 2	Model 3
<i>Fixed effects</i>				
Intercept	−0.04	−0.06*	−0.05	−0.04
Arousal		0.01***	0.01***	0.01***
Partner (most vs. least)			−0.47***	−0.47***
Target (partner vs. self)			0.03	0.04
Arousal*Partner				0.002***
Arousal*Target				−0.002**
Partner*Target				−0.14***
Arousal*Partner*Target				0.003**
<i>Random effects</i>				
Intercept variance	0.35***	0.36***	0.36***	0.36***
Residual variance	0.35***	0.25***	0.18***	0.18***
Arousal variance		0.00004***	0.00004***	0.00004***
<i>Fit statistics</i>				
−2LL	8498.47	7530.20	6485.10	6418.76
AIC	8504.47	7540.20	6499.10	6440.76
BIC	8523.51	7571.94	6543.54	6510.60
Effect size (Level 1)	–	0.30	0.48	0.49
Effect size (Level 2)	–	−0.01	−0.03	−0.04

Most and least desirable partners were coded as 0.5 and −0.5, respectively. Partner-arousal and self-arousal (target) groups were coded as 0.5 and −0.5, respectively. Effect size (Level 1)=the proportion reduction in residual variance from the unconditional model. Effect size (Level 2)=the proportion reduction in intercept variance from the unconditional model

* $p < .05$, ** $p < .01$, *** $p < .001$

condition and AUC in the least-desirable-partner condition. Additionally, we conducted Mann–Whitney U tests to test (1) group difference (self-arousal vs. partner-arousal) and (2) sex difference (men vs. women) in AUC for each partner condition.

Finally, separate regression analyses were conducted to test if the AUC from each partner condition was associated with (1) self-efficacy for condom use, (2) self-efficacy for negotiating safer sex, and (3) frequency of unprotected casual sex in the past 3 months (log-transformed). For the frequency of unprotected casual sex, we also controlled for age and total number of casual sexual encounters in the past 3 months (log-transformed).²

Data and supplemental material can be found at: <https://osf.io/xe8u7/>.

Results

Effect of Arousal Level (H1)

Results from MLM showed that the fixed effect of sexual arousal on overall willingness to use a condom was significant even after controlling for covariates and interactions ($p < .001$; Table 1). Participants, on average, were less willing to use a condom when sexual arousal decreased due to condom use. The random effect of sexual arousal was also significant ($p < .001$; Table 1), suggesting that the influence of sexual arousal on willingness to use a condom differed significantly from person-to-person.

Effect of Partner Desirability (H2)

Results from MLM showed that participants had higher overall VAS ratings (less reported willingness to use a condom) with the most (vs. least) desirable partner ($p < .001$; Table 1). In addition, results from the Wilcoxon signed-rank test showed that AUC in the most-desirable-partner condition ($M = 0.71$, $SD = 0.28$) was significantly lower than the AUC in the least-desirable-partner condition ($M = 0.86$, $SD = 0.21$; Wilcoxon = 16,729, $z = 9.68$, $p < .001$). This means participants discounted safe sex more with their most (vs. least) desirable partner when condom use reduced arousal level.

² We also conducted a supplementary analysis regarding how the AUC was associated with (1) impulsivity and sensation seeking and (2) sexual sensation seeking. These results are included in the online supplemental material.

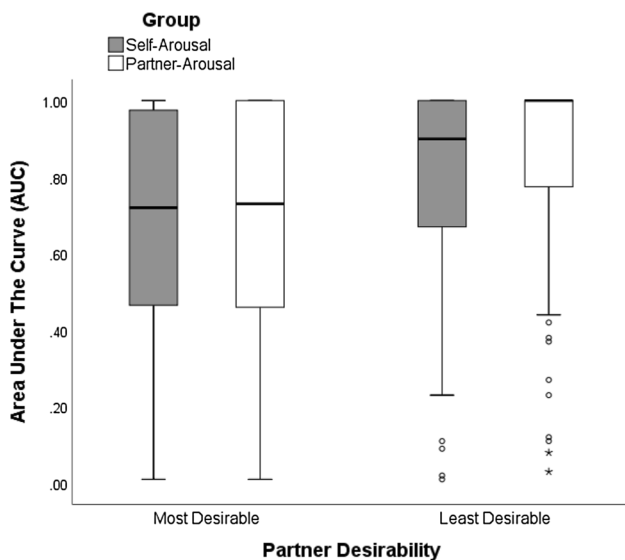


Fig. 1 Box plots showing AUCs of the self-arousal group and the partner-arousal group (R1). AUC=area under the discounting curve (ranging from 0 to 1). Lower AUC=higher arousal discounting. The two boxes on the left represent both groups' AUCs in the most-desirable-partner condition. The two boxes on the right represent both groups' AUCs in the least-desirable-partner condition. The gray boxes represent the self-arousal group's AUCs, and the white boxes represent the partner-arousal group's AUCs. Open circles (o) represent outliers, and asterisks (*) represent extreme cases

Effect of Arousal Target (R1)

Results from MLM showed no significant difference in overall reported willingness to use a condom between the two arousal target groups ($p = .484$; Table 1). Further, in the most-desirable-partner condition, there was no significant difference in AUC between the self-arousal ($M \text{ rank} = 157.45$) and partner-arousal groups ($M \text{ rank} = 157.56$; $U = 12,315$, $z = 0.01$, $p = .991$). However, in the least-desirable-partner condition, the partner-arousal group ($M \text{ rank} = 155.11$) had higher AUC (less discounting) than the self-arousal group ($M \text{ rank} = 132.97$; $U = 11,884.50$, $z = 2.37$, $p = .018$). That is, when making decisions about using a condom with the least desirable partner, participants whose own sexual arousal was impacted by condom use discounted safe sex more than participants whose partner's arousal was impacted. Figure 1 shows the AUCs for each group in the most- and least-desirable-partner conditions.

Interactions Between Arousal Level, Partner Desirability, and Arousal Target (R2)

All two-way and three-way interactions were significant among arousal level, partner desirability, and arousal target (Table 1). Thus, only the highest order of interaction (the three-way interaction) was interpreted. As sexual arousal

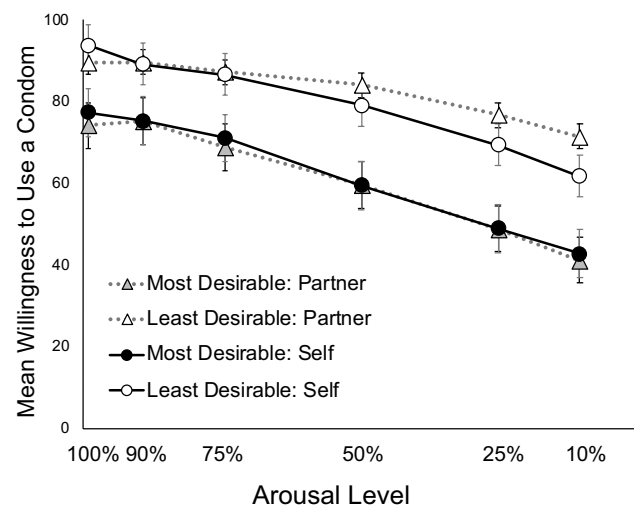


Fig. 2 Effects of arousal level, partner desirability, and arousal target (H1, H2, R1, R2). The y-axis shows mean willingness to have sex with a condom (raw ratings). The x-axis shows six levels of sexual arousal. The gray-dotted lines represent the partner-arousal group (when a condom decreased their partner's arousal). The black bold lines represent the self-arousal group (when a condom decreased their own arousal). The gray triangular and black circle markers represent participants' most desirable partner. The white triangular and white circle markers represent participants' least desirable partner. Error bars represent SEM

from condom use decreased, participants in the self-arousal group showed similar reductions in likelihood of condom use for their most and least desirable partners (i.e., the two data paths change in parallel, though absolute likelihood of condom use differed). In contrast, as sexual arousal from condom use decreased, participants in the partner-arousal group showed different reductions in the likelihood of condom use for the most and least desirable partners (i.e., the two data paths diverge as arousal percentage decreases in addition to absolute differences in likelihood of condom use). Figure 2 shows the effects of arousal level, partner desirability, and arousal target on willingness to use a condom.

Sex Differences (R3)

Figure 3 shows the AUCs for men and women in the most- and least-desirable-partner conditions. In the most-desirable-partner condition, men ($M \text{ rank} = 131.14$) had a lower AUC than women ($M \text{ rank} = 171.71$; $U = 8320.50$, $z = -3.81$, $p = .001$). That is, men discounted safe sex as a function of reduced arousal more than did women with the most desirable partner. However, there was no significant sex difference in AUC in the least-desirable-partner condition ($M \text{ rank} = 133.69$ for men and 149.86 for women, $U = 8443.50$, $z = -1.66$, $p = .096$).

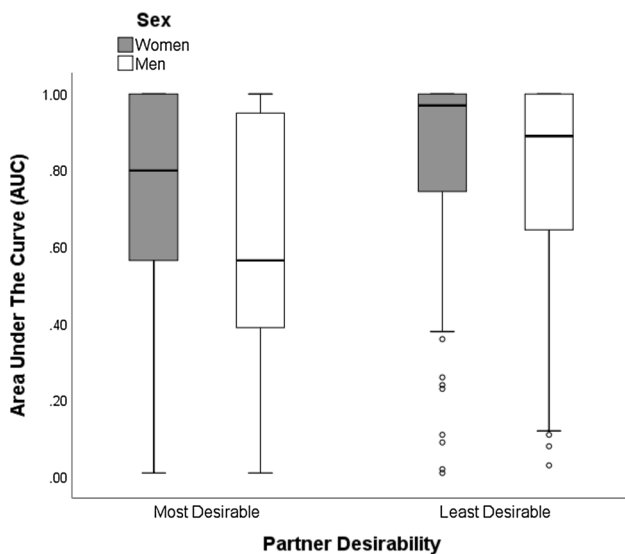


Fig. 3 Box plots showing AUCs of men and women (R3). AUC=area under the discounting curve (ranging from 0 to 1). Lower AUC=higher arousal discounting. The two boxes on the left represent women's and men's AUCs in the most-desirable-partner condition. The two boxes on the right represent women's and men's AUCs in the least-desirable-partner condition. The grey boxes represent women's AUCs, and the white boxes represent men's AUCs. Open circles (o) represent outliers

Relationship Between Area Under the Curve and Safe-Sex Self-Efficacy (H3a)

Lower AUCs (more discounting) in both partner conditions were associated with lower self-efficacy for condom use ($b = 4.53$, $t[300] = 4.91$, $r_p = .27$, $p < .001$, 95% CI [.16, .37] in the most-desirable-partner condition; $b = 6.17$, $t[274] = 4.63$, $r_p = .27$, $p < .001$, [.16, .38] in the least-desirable-partner condition). Lower AUCs in both partner conditions were also associated with lower self-efficacy for negotiating safer sex ($b = 2.27$, $t[305] = 3.72$, $r_p = .21$, $p < .001$, [.10, .31] in the most-desirable-partner condition; $b = 3.21$, $t[280] = 3.70$, $r_p = .22$, $p < .001$, [.10, .32] in the least-desirable-partner condition).

We also averaged the AUC scores across the most- and least-desirable-partner conditions for each participant. Lower mean AUC across two partner conditions was associated with lower self-efficacy for condom use ($b = 5.73$, $t[321] = 5.36$, $r_p = .29$, $p < .001$, [.18, .38]) and lower self-efficacy for negotiating safer sex ($b = 2.79$, $t[326] = 3.94$, $r_p = .21$, $p < .001$, [.11, .31]).

Relationship Between Area Under the Curve and Past Condom Use (H3b)

When controlling for total number of sexual encounters and age, participants with lower AUC (more discounting) in the

most-desirable-partner condition reported a higher (logged) frequency of unprotected sex ($b = -0.80$, $t[84] = -3.02$, $r_p = -.31$, $p = .003$, [−.49, −.11]). In contrast, AUC in the least-desirable-partner condition was unrelated to participants' reported frequency of unprotected sex ($b = -0.56$, $t[76] = -1.44$, $r_p = -.16$, $p = .154$, [−.37, .06]).

We also averaged the AUC scores across the most- and least-desirable-partner conditions for each participant. Participants with lower mean AUC (more discounting) across two partner conditions reported a higher (logged) frequency of unprotected sex ($b = -0.75$, $t[91] = -2.44$, $r_p = -.25$, $p = .017$, [−.43, −.04]).

Discussion

The results supported all three hypotheses. Participants' willingness to use a condom decreased as sexual arousal decreased from condom use (H1). Participants discounted condom-protected sex more with their most (vs. least) desirable partner (H2). Finally, higher arousal discounting was associated with lower self-efficacy for condom use and negotiation (H3a), and higher arousal discounting with the most (not least) desirable partner was associated with higher reported frequency of unprotected sex in the past 3 months (H3b).

As sexual arousal decreased via condom use, participants' reported overall willingness to have protected sex decreased (fixed effect). Further, some participants discounted safe sex as a function of reduced arousal more or less than others (random effect). Consistent with past discounting studies (e.g., Johnson & Bruner, 2012), participants in this study discounted safe sex more (had lower AUC) with their most (vs. least) desirable partner. This suggests that people are more likely to forgo condoms and be fully aroused when having sex with a highly desirable partner. Whether the participant's own arousal or their partner's arousal reduced from condom use had no effect on overall condom use. In addition, when a partner was the most desirable, participants in both groups showed a similar decline in willingness to have safe sex (i.e., regardless of whose arousal was impacted). However, when a partner was the least desirable, participants in the self-arousal group (their own arousal was reduced) discounted safe sex more than those in the partner-arousal group (their partner's arousal was reduced).

These findings make logical sense. When the partner was highly desirable, both their partner's and their own sexual pleasure might be equally important. For instance, people might want an attractive partner to have a good sexual experience with them because it may increase the likelihood of seeing that partner again. This would lead to similar decisions for the highly desirable partner regardless of whether one's own or the partner's arousal was decreased by condom use. In

addition, participants might tend to make riskier choices with attractive partners regardless of whose arousal was reduced because attractiveness is often associated with decreased perceived STI risks and condom use intentions (Eleftheriou et al., 2016, 2019; Sarno & Mohr, 2019). In contrast, when the partner is not highly desirable, participants might make decisions based more on whether they themselves were affected by condom use. Therefore, participants in the self-arousal group still showed relatively high discounting because a condom affected their own sexual functioning. In the partner-arousal group, however, the sexual pleasure of their less attractive partner might be of less concern.

We also found a significant three-way interaction between arousal level, partner desirability, and arousal target. As sexual arousal decreased, participants in the self-arousal group showed similar rates of reduction in willingness to have protected sex for both most and least desirable partners (though absolute willingness differed between partners). Compared to the self-arousal group, participants in the partner-arousal group showed a similar pattern of greater discounting for the most desirable partner. However, the partner-arousal group exhibited lower discounting for the least desirable partner, and there was a clearer difference in the rate of sexual arousal discounting between the most and least desirable partners in this group. In other words, when the partner was less desirable, the partner-arousal group showed less change in reported willingness to use a condom as a function of reduced sexual arousal.

The results of this study fit within the existing literature that suggests men, on average, are sexually riskier than women (e.g., Skakoon-Sparling et al., 2016). Consistent with past findings, men in this study discounted safe sex more than women, but only when the partner was the most desirable. Thus, men were not always more willing to take sexual risk than women. It is possible that men's (vs. women's) condom-use decision-making is more affected by a partner's attractiveness.

As expected, higher arousal discounting (lower AUC) was associated with lower safe-sex self-efficacy. Safe-sex self-efficacy, such as one's confidence in using a condom or negotiating condom use with a partner, is an important determinant of safe sex behavior (Asante et al., 2016; Nesoff et al., 2016). In this study, participants with higher arousal discounting (discounted safe sex more) reported lower confidence in using condoms during sexual activities. They also reported lower confidence in negotiating condom use with their sexual partner(s).

We also examined the relationship between sexual arousal discounting and the reported frequency of unprotected casual sex. We found that participants with higher arousal discounting (lower AUC) reported more unprotected sex in the past 3 months. However, this association was found only when using AUC from the most-desirable-partner (not the

least-desirable-partner) condition. Because many participants preferred having protected sex with their least desirable partner regardless of arousal level, the amount of discounting was generally low in this partner condition (the floor effect). Thus, sexual arousal discounting with the least desirable partner, unlike the most desirable one, may not predict well people's real condom-use behavior. Nevertheless, the relationship between mean AUC and unprotected sex was significant—those who had lower AUC (higher discounting) across two partner conditions reported more unprotected sex. Taken together, the findings suggest that people may be at higher risk for STIs if they are less willing to use a condom for the sake of sexual arousal.

Implications

Our findings have several implications. First, people's willingness to have protected sex were influenced by sexual arousal in a manner consistent with a discounting framework. Thus, the present study adds to a growing literature showing that sexual discounting can be used to understand various aspects of sexual risk-taking behavior. Specifically, our study demonstrated that reduced sexual arousal from condom use is another relevant dimension of sexual decisions to use a condom along with the delay to condom access (e.g., Johnson & Bruner, 2012) and the probability of contracting an STI (e.g., Johnson et al., 2015a, b).

Because sexual arousal discounting was associated with safe-sex self-efficacy and real condom-use behavior (including sexual and impulsive sensation seeking; see the supplemental material), the SAD task may have practical importance. Researchers might be able to use this task as an alternative assessment of sexual risk-taking. However, the psychometric properties of this task are untested; thus, researchers and clinicians should be cautious when using the task in a high-stakes testing. In addition, to further understand the factors relating to devaluation of protected sex as a function of reduced arousal, researchers can use the SAD task to study the correlates of sexual arousal discounting in future research.

Methodologically, our findings provided two important implications for future sexual discounting studies. First, factors other than delay and probability can influence sexual risk-taking and can be manipulated within a discounting framework. This creates many opportunities for researchers to explore factors that affect sexual discounting. Second, we found that 22% of the participants preferred to opt out of having sex rather than choosing between sex with and without a condom, that partner desirability influenced decisions to opt out, and that women opted out more than men (see the supplemental material). Future sexual discounting studies should

consider including the opt-out option in their discounting tasks to prevent biased results.

Further, sexual risk reduction and prevention interventions should pay special attention to the factors affecting devaluation of condom-protected sex as a function of reduced arousal. For example, educators may help people realize their vulnerability with attractive partners even when they have an intention to use a condom. However, educators and therapists should also keep in mind that the mechanisms underlying discounting of condom-protected sex are likely to be complex. For instance, although people may be more willing to have safe sex with less attractive partners, this may not be true when a condom affected their own sexual arousal. In addition, sex education programs should emphasize the importance of sexual pleasure when promoting safer sex (e.g., focusing on how safe sex can be pleasurable sex; Philpott, Knerr, & Boydell, 2006).

Limitations and Future Directions

One limitation of the current study was the use of percentages to describe reductions in sexual arousal from condom use. For example, it may have been unclear to some participants what exactly 10% sexual arousal means. Although the experimental design allowed for the systematic manipulation of our variable of interest (sexual arousal), we might sacrifice the extent to which an experimental situation resembles a real-life situation (mundane realism) as a result. This could, in turn, lessen the ecological validity. Future experimental studies should find the ways to increase the realistic presentation of arousal. Additionally, although we gave the definition of sexual arousal at the beginning of the study, sexual arousal may involve different physiological responses and be hard to describe verbally for many people. Future research may employ other variables, such as sexual pleasure or satisfaction, that may be more intuitive or easier to understand.

A second limitation was that the sample of this study consisted of college students and may not be representative of the general population. In addition, the amount of discounting in this sample was not very high ($AUC \approx 0.7\text{--}0.8$). Thus, our results may not generalize to other populations who are also at high risk for STIs and who typically demonstrate higher rates of discounting (e.g., drug users, men who have sex with men). Relatedly, the younger age of the current sample suggests that the participants in the present study may have less sexual experience than the larger population. Because our task was completely hypothetical, participants did not need to have sexual experience or be sexually active at the time of participation. However, it is possible that people with less sexual experience have less insight into what they would do in real situations. In this study, we found no significant difference in discounting rates between virgin and nonvirgin participants, but future

studies might still consider examining sexual arousal discounting in a more sexually experienced sample.

A third limitation was that women who exclusively have sex with women were not included in this study because the study focused on male condom use, which was the most common outcome variable in typical sexual discounting studies (e.g., Berry et al., 2019; Herrmann et al., 2014; Johnson & Bruner, 2012). As condoms are usually perceived as more relevant to penile–vaginal or penile–anal sexual intercourse, women with female partners might feel that the study was not relevant to them if they were to be included in this study. Nonetheless, it does not mean that research on this population is unimportant. Although rates of STIs, especially those that can be effectively prevented by condoms (e.g., HIV), in gay women are relatively rare (CDC, 2017; Everett, 2013; Tao, 2008), some STIs (e.g., bacterial vaginosis) are common among women with female partners (Bauer & Welles, 2001; Gorgos & Marrazzo, 2011; Takemoto et al., 2019). Therefore, future sexual discounting studies should focus on gay women (e.g., using a dental dam instead of a condom) to inform sex education in this population.

Next, the statistical power to detect a relationship between sexual arousal discounting and unprotected casual sex was lower because only 27% of the participants ($n = 107$) had casual sex in the past 3 months. The nonsignificant result in the least-desirable-partner condition could have resulted from being underpowered rather than suggesting the absence of a real effect. It is also worth noting that the relationships between sexual arousal discounting and safe-sex self-efficacy as well as the frequency of unprotected sex were correlational. Therefore, we cannot make any causal claim regarding the direction of these relationships.

Because the SAD task is a newly developed measure, the validity and utility of the task should continue to be explored. For example, future studies may compare the SAD task and other sexual discounting tasks (or traditional discounting tasks using monetary rewards) to examine the concurrent validity of the task. Future studies may also employ a longitudinal design to test if performance on the SAD task can predict future sexual risk-taking behavior. Finally, clinical utility of the SAD task could be examined by determining whether the task can distinguish between clinical populations (e.g., those who tested positive for STIs) vs. subclinical populations (e.g., those who tested negative for STIs).

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Compliance with ethical standards

Conflict of interest The authors declare no conflict of interest.

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