Effects of behavioral risk factors on hypothetical sexual decision-making

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Abstract

As sexual behavior increases in late adolescence and young adulthood, so too does the likelihood of having unprotected sex, resulting in potentially serious, negative consequences including STD contraction or unintended pregnancy. One explanation for engagement in sexual risk behavior at this age may involve probability discounting of condom-protected sex. Probability discounting refers to a process of the devaluation of a consequence in response to uncertainty, and provides a unique method to examine sexual decision-making. The present study was conducted entirely online in a population of college-aged individuals (n = 59). Once informed consent was provided, and eligibility was determined, the Sexual Probability Discounting Task (SPDT) was administered. The SPDT measured the likelihood of a behavior (i.e., condom use) in response to systematically increasing odds against a certain outcome's occurrence (i.e., pregnancy, STD, unknown). In addition to this task, measures were included to assess condom attitudes, sexual knowledge, and sexual risk behaviors. Results revealed a systematic decrease in the likelihood of condom use as the odds against each of the three potential outcomes decreased; discounting was greater for a more desirable partner compared to a less desirable partner. Participants discounted less in the pregnancy and unknown conditions (i.e., were more likely to use a condom) compared to the STD condition (i.e., less likely to use a condom). Results of this study are likely to inform potential intervention and prevention strategies prevent these negative consequences of risky sexual behavior.

Keywords: sexual risk, sexually transmitted disease, probability discounting, sexual knowledge, college students

Sexual behavior is a common occurrence in late adolescence and young adulthood, which is unsurprising given that this is a period of peak fertility (Tapert et al., 2001). With an increase in sexual behavior, the likelihood of having unprotected sex also increases, resulting in potentially serious, negative consequences for young adults. In the United States, individuals between the ages of 15 and 24 were responsible for 9.1 million new diagnosed cases of sexually transmitted diseases (STDs) during the year 2000; the estimated lifetime economic impact of these new diagnoses was $6.5 billion dollars (Chesson, Blandford, Gift, Tao, & Irwin, 2004). The impact of an STD contraction often extends beyond the realm of physical health: Brown et al. (2010) identified a relation between STD diagnosis and diminished mental health in adolescent populations. Although it is unclear whether STD diagnosis increases the risk of poor mental health outcomes, this and other findings highlight the often serious and negative outcomes of risky sexual behavior.

In addition to the risk of contracting an STD, another negative outcome of unprotected sex is unintended pregnancy. It was estimated that 45% of total pregnancies in 2011 were unintended (Finer & Zolna, 2014), and that young women between the ages of 18 and 29 were more likely to experience an unintended pregnancy than any other age group (Frost, Lindberg, & Finer, 2012). Poor mental health outcomes have also been reported by a group of women who experienced an unintended pregnancy early in life (Herd, Higgins, Sicinski, & Merkurieva, 2016), suggesting that the negative outcomes associated with unprotected sex are long-lasting. Like STDs, unintended pregnancies are economically taxing: In 2010, 68% of the 1.5 million unplanned births were paid for by public insurance programs, resulting in the total estimated cost of $21 billion dollars in both state and federal funding (Bradburn, 2002). In addition to being very costly, unintended pregnancies can have a negative impact on the parent. According to the

United States Department of Education (2002), 61% of community college students who have children after enrolling do not complete their degrees. In response to these concerns, many school-based interventions attempt to increase knowledge of risk outcomes associated with sexual behavior in the hope that knowledge will promote safe-sex behavior (e.g., condom use).

With such serious, long-term consequences of unprotected sex, there are obvious benefits to providing sexual education before sexual risk behavior occurs. Unfortunately, there has been a decline between 2000 and 2014 in the number of schools in the United States providing sexual health education (CDC, 2014), as well as a decline in formal education covering contraception, STDs, and consent within curriculum (Lindberg, Maddow-Zimet, & Boonstra, 2016). In a recent study, knowledge about contraceptive effectiveness was assessed in a large sample of 1,800 people between the ages of 18 and 29; the researchers observed that more than half of the males, and one-quarter of the female participants, scored low on contraceptive knowledge (Frost, Lindberg, & Finer, 2012). By and large, however, the relation between sexual knowledge and sexual risk behavior in late adolescence and adulthood is relatively unknown. Notably, Graf and Patrick (2015) studied how sexual education and knowledge influence risky sexual behavior in middle and late-adulthood. They observed that while knowledge of sexual risk outcomes was high, middle-adults to late-adults (i.e., ages 40-77) still engaged in risky sexual behaviors. Unfortunately, a cohort effect may have diminished the generality of these results, given that the average age of participants was 54 years old and sexual education during their adolescence may have been limited in accuracy and availability of information. Despite this limitation, it would seem that increased sexual risk behaviors are not due to a lack of knowledge, and that other mechanisms may be responsible for engagement in sexual risk behavior.

One explanation for the apparent disconnect between sexual knowledge and sexual risk behavior may involve the discounting of condom-protected sex. The behavioral principle of delay discounting describes the manner in which a reward loses its value as the delay to that reward increases. Steep delay discounting (i.e., significant loss of reward value as a function of reward delay) is associated with problematic behaviors such as pathological gambling (e.g., Dixon, Marley, & Jacobs, 2003), obesity (e.g., Weller et al., 2008), and substance use (e.g., MacKillop et al., 2011). Recently, Johnson and Bruner (2012) developed the Sexual Delay Discounting Task (SDDT), which applied this delay discounting framework to the hypothetical use of a condom during intercourse. Specifically, participants were told to imagine that they would have to wait a specified amount of time before they could have condom-protected intercourse with a hypothetical partner that they selected from a set of photographs. Johnson and Bruner also investigated the effects of partner desirability and perceived STD status by having participants identify which individuals represented their most and least desirable partner, as well as which individuals they perceived as being the most and least likely to have an STDs.

Results revealed that as the delay to condom access increased, condom use likelihood decreased systematically (i.e., participants were more likely to engage in unprotected sex immediately). Johnson and Bruner also observed that participants were more likely to discount condom-protected sex for the partner that they judged to be more desirable, as well as for the partner they indicated was less likely to have an STD. These results illustrate that partner characteristics influence sexual decision-making and may be a driving force in risk behavior. Subsequent studies involving the SDDT have observed systematic delay discounting of condom-protected sex in men who have sex with men (Herrmann, Johnson, & Johnson, 2015), as well as in participants who were cocaine dependent (Johnson & Bruner, 2012; Johnson, Johnson,

Herrmann, & Sweeney, 2015), and women who were opioid-dependent (Herrmann, Hand, Johnson, Badger, & Heil, 2014), suggesting that the task can be used to examine hypothetical sexual decision-making in high-risk populations.

Because of the increased risk for contracting an STD and/or experiencing an unintended pregnancy, young adults are an especially vulnerable population and could stand to benefit from an examination of their decision-making within the sexual discounting framework. A study conducted by Dariotis and Johnson (2015) examined hypothetical sexual decision-making in young adults (ages 18 to 24) who were classified as high-risk in relation to substance use and sexual risk behaviors. As in Johnson and Bruner (2012) and other SDDT studies, the SDDT was administered with manipulations of partner desirability and perceived STD status. Partner effects were once again observed, with greater discounting of condom-protected sex for hypothetical partners that were rated as more desirable and less likely to have an STD. In addition to this finding, a significant correlation was also observed between greater discounting of condom-protected sex and self-reported sexual risk behavior. The link between sexual risk behavior and delay discounting illustrates the utility of the SDDT as a potential screening tool to identify individuals who may benefit from targeted intervention.

More recently, Johnson and colleagues investigated the effects of STD risk on hypothetical condom use by adapting the SDDT to include a phenomenon related to delay discounting known as probability discounting. The hypothetical Sexual Probability Discounting Task (SPDT) manipulates the likelihood of a certain risk outcome (i.e., contracting an STD with systematic decreases in the probability of its occurrence, 100%, 33%, 8%, 1%, .25%, .14%, .05%, .01%; Johnson et al, 2015). When these probabilities were converted to odds against STD contraction and participant ratings of likelihood of condom use were plotted accordingly,

significant decreases in hypothetical condom use were observed. A hypothetical probability discounting curve is illustrated in Figure 1 and visually illustrates the discounting of condom use likelihood in response to decreasing odds against the risk of contracting an STD.

To date, all of the studies that have administered the SPDT have exclusively manipulated the probability of STD contraction. However, as described above, STD contraction is only one of several negative outcomes associated with unprotected sex. Unintended pregnancy is also a highly salient risk for heterosexual young adults engaged in unprotected intercourse. The present study therefore sought to implement the SPDT by experimentally manipulating the likelihood of contracting an STD, as well as, in a separate condition, the likelihood of becoming pregnant or impregnating one's hypothetical partner. An additional third condition was included in which either outcome could occur (i.e., a condition designed to mirror the truly unpredictable consequences of unprotected intercourse). These findings may have important implications for prevention efforts based on which of the two outcomes—STD contraction or unintended pregnancy—is associated with steeper discounting of condom-protected sex.

Since young adults are at higher risk for negative outcomes following risky sexual behavior, the examination of undergraduate university students in the present study was appropriate, as well as convenient. Their status as a high-risk group, coupled with limited research on sexual probability discounting within this demographic, are two clear reasons to conduct this research. The aims of this study were to evaluate hypothetical condom use in undergraduate students in response to varying probability of the risk for contracting an STD, an unintended pregnancy, or an unknown outcome. Other sexual risk measures were examined, including the effects of existing knowledge relating to sexual risk outcomes, sexual risk behavior, and attitudes toward condom use.

Method

Participants

Participants consisted of undergraduate students recruited from the Psychology department of California State University, Chico, through the department's SONA research website (https://csuchico.sona-systems.com/), as well as through advertisements posted on the research board in the Psychology department. After reading and electronically signing an informed consent form, potential participants were required to complete a brief screening questionnaire. In order for participants to qualify for the study, they were required to: (1) be 18 years of age or older, (2) identify as single, (3) be comfortable answering questions about their sexual history, (4) have had sexual intercourse (i.e., vaginal or anal sex) in their lifetime, (5) have had at least one lifetime instance of unprotected sexual intercourse (i.e., sex without a condom), (6) be sexually active (i.e., have had vaginal or anal intercourse with a partner within the last 12 months), (7) not be currently pregnant or attempting to become pregnant or impregnate their partner, and (8) not have a current STD.

Materials and Procedure

Screening Questionnaire

The screening questionnaire contained questions regarding participant demographics and sexual behavior history. If participants were uncomfortable answering questions about their sexual history, they were not shown questions regarding sexual intercourse and were instead redirected to the end of the screening questionnaire.

Demographic Questionnaire

If a participant was determined to be eligible for the main survey, they were first asked to provide their demographic characteristics upon visiting the main survey. Questions were asked about each participant's age, sex, race, and education.

Photograph Selection for Sexual Probability Discounting Task (SPDT)

Prior to the SPDT, participants were shown an array of photographs and were asked to select the individuals with whom they would be interested in having hypothetical sexual intercourse. The array was composed of 60 photographs (30 male, 30 female) of individuals with varying backgrounds and physical characteristics. Photographs were selected from free domain photo images found online and were selected to match the racial demographic distribution of students at California State University, Chico. Following picture selection, participants were asked to identify two hypothetical partners from the reduced array: (1) the partner with whom they would most want to have sex and (2) the partner with whom they would least want to have sex. The same photographed individual could not be used in both partner conditions. Therefore, participants who chose fewer than 2 photographs from the full array did not complete the SPDT for practical reasons.

Sexual Probability Discounting Task

Participants were randomly assigned to complete the SPDT partner conditions in varying orders (e.g., "most want to have sex with" partner first, followed by the "least want to have sex with" partner, or vice versa). The order of the first two outcome conditions (STD contraction and pregnancy; described below) was also randomized. Within each condition, participants were asked to rate the likelihood of condom use during a hypothetical sexual situation. To this end, participants used a visual analogue scale ranging from 0 ("I will definitely have sex with this person without a condom") to 100 ("I will definitely have sex with this person with a condom")

to indicate their likelihood of condom use. Within each condition and for each partner, the initial risk associated with unprotected sex always began at a 1 in 1 chance (100%) of a specified outcome (e.g., STD contraction or pregnancy). Risk was decreased systematically across subsequent trials (1 in 3 chance [33%], 1 in 13 chance [8%], 1 in 100 chance [1%], 1 in 400 chance [.25%], 1 in 700 chance [.14%], 1 in 2,000 chance [.05%], and 1 in 10,000 chance [.01%]). For each of the two partner conditions, participants completed three conditions in which the negative outcome associated with unprotected sex was manipulated. We assessed the risk of contracting an STD, the risk of becoming pregnant or impregnating one's hypothetical partner, or an unknown risk (STD contraction or pregnancy).

UCLA Multidimensional Condom Attitudes Scale (MCAS)

To assess attitudes toward condom use, the UCLA Multidimensional Condom Attitudes Scale (MCAS) was implemented (Helweg-Larsen & Collins, 1994). This questionnaire included 25 items on a six point Likert scale, ranging from 1 (Strongly Disagree) to 6 (Strongly Agree). Helweg-Larsen and Collins reported internal consistency for the following five sub-scales: (1) reliability and effectiveness of condoms (a = .73), (2) pleasure associated with condom use (a = .77), (3) stigma associated with condom use (a = .72), (4) embarrassment about the negotiation of condom use (a = .78), and (5) embarrassment about purchasing condoms (α = .89).

Multi-factor Attitude toward Condom Scale (MFACS)

To assess participant's attitudes toward condoms, a bipolar 7-response matrix with 14 statements was provided to participants (Reece, Herbenick, Hollub, Hensel, & Middlestadt, 2010). Participants indicated which statement they most agreed with in response to the following general question, "I would describe condoms as…" This scale contains five sub-scales assessing the following attitudes: reliability and effectiveness of condoms, pleasure associated with

condoms, stigma associated with condoms, embarrassment about negotiation and use of condoms, and embarrassment about purchasing condoms. Reece et al. found that the overall internal consistency of the MFACS was good (α = .81), and that the MFACS had good test-retest reliability (2 weeks; *r* = .75).

Sexual Risk Survey

The Sexual Risk Survey (SRS; Turchik & Garske, 2009) is a 26-item qualitative questionnaire assessing sexual risk behavior over the past six months. A sexual terms glossary containing a comprehensive list of all sexual terms covered in the SRS accompanied each item. Turchik and Garske found that internal consistency for SRS was good (α = .88).

Sexually Transmitted Disease Knowledge Questionnaire (STD-KQ)

To assess participant knowledge about sexually transmitted diseases, the Sexually Transmitted Disease Knowledge Questionnaire (STD-KQ) was used (Jaworski & Carey, 2007). This questionnaire is a 27-item assessment of knowledge, and presents statements about sexually transmitted diseases and provides three response options (“True,” “False,” and “I don't know”). Jaworski and Carey found that the internal consistency of the SRS was good (α = .86).

Procedure

The screening questionnaire and main survey were conducted online at the participant’s convenience and discretion (Qualtrics, Inc.; Provo, UT). Once eligibility was determined by the screening questionnaire, a password for participation was provided and participants were instructed to follow a link which directed them to the main survey. Informed consent was obtained from all individual participants included in the study preceding any activity.

Data Analysis

As in prior research implementing the SPDT (e.g., Johnson et al., 2015; Johnson, Herrmann, Sweeney, LeComte, & Johnson, 2017; Johnson, Sweeney, Herrmann, & Johnson, 2016), participants who selected fewer than two pictures were excluded from analysis. To characterize the effect of outcome risk on condom use likelihood, participant values were fitted using a two-parameter hyperbolic discounting equation (Myerson & Green, 1995). For statistical analyses, area-under-the-discounting-curve (AUC) values were calculated for each individual subject. AUC values were determined by dividing the area under the curve by the total graphical area, resulting in a proportion ranging from 0 to 1, with smaller AUC values indicating steeper discounting (i.e., less likely to use a condom; Myerson, Green & Warusawitharana, 2001). Differences in AUC scores for each of the six conditions (2 partner conditions x 3 outcome conditions) were examined using a two-way repeated measures analysis of variance (ANOVA). Two, separate one-way ANOVA's were conducted to compare AUC scores for each partner condition across outcome conditions. Paired-samples *t*-tests were used to compare AUC across partner conditions, in each of the three outcome conditions. To score non-discounting measures (i.e., MFACS, MCAS, STD-KQ), the sum of each participant's score on each item were taken as a dependent measure. Rather than use a total score, the SRS instead used individual participant's scores for each item to correlate with AUC scores and other measures. Correlational analyses between AUC scores and other study measures were also conducted.

Results

Three hundred and four individuals completed the screening questionnaire and 83 (27%) were eligible. From that group, 71 (86%) participants signed up for, and completed the main survey. Three participants did not finish the main survey, and 8 (11%) participants did not complete the SPDT because they chose fewer than two pictures, or indicated that they would not

have sex with any of the photographed individuals in the array. Therefore, the terminal sample size was $n = 59$. Table 1 shows demographic information for the sample.

Sexual Probability Discounting Task

Twenty-eight of 2,784 likelihood values (1.01%) were missing at random. Missing data were imputed by taking the average of the participant's adjacent likelihood values; when the first or last data point was missing, the most proximate data point was substituted. Figure 2 illustrates the best-fit discounting curves from a two-parameter hyperbolic discounting equation to mean likelihood values as a function of odds against an outcome's occurrence (Myerson & Green, 1995). This equation fit the data very well, with R^2 scores ranging from .82 to .96. Separate curves are shown for each partner ("most want to have sex with" and "least want to have sex with") for each outcome type (pregnancy, STD contraction, and unknown; shown in separate graphs). Figure 3 shows mean AUC scores for each of the six conditions. For all 3 outcome types, increased partner desirability resulted in increased discounting of condom-protected sex as a function of odds against each outcome's occurrence. Greater discounting of condom-protected sex was observed for the STD contraction condition compared to the pregnancy or the unknown outcome conditions.

These qualitative findings were confirmed statistically through a two-way repeated-measures ANOVA with a Greenhouse-Geisser correction. The interaction between partner and outcome type was not significant. A significant main effect for outcome condition was observed $F(1.7, 2.1) = 14.3$, $p < .001$ ($\eta p^2 = .20$). Separate repeated-measures ANOVAs were conducted to compare AUC values for the "most want to have sex with" and "least want to have sex with" partners for each of the three outcome conditions. A significant main effect was observed for the "most want to have sex with" partner across the three outcome conditions $F(1.7, 1.5) = 18.3$, $p <$

.001, ηp^2 = .24. Post-hoc tests using a Bonferroni correction revealed that AUC scores for the unknown outcome condition (M = .76, SD = .36) was significantly higher than the pregnancy (M = .59, SD = .40) or STD contraction (M = .47, SD = 42) conditions (pregnancy: p = .001 STD contraction: p = .001. AUC values for the "least want to have sex with" partner were also compared across the three outcome conditions using a repeated measures ANOVA. A significant main effect was observed $F(1.5,.82 = 5.01$, $p < .05$, ηp^2 = .1. Post-hoc tests implementing the Bonferroni correction showed that, consistent with the "most want to have sex with" partner conditions, AUC values were significantly higher in the unknown outcome condition (M = .84, SD = .31) than the pregnancy (M = .71, SD = .40) or STD contraction (M = .64, SD = .40) conditions (pregnancy: p = .01; STD contraction: p = .02).

A significant main effect of partner condition was also observed in the two-way repeated-measures ANOVA, $F(1,57) = 14.18$, $p < .001$, ηp^2 = .20. Significant differences were observed between the AUC values for the two partners in all three outcome conditions. Specifically, there were significant differences in the mean AUC for "most want to have sex with" and "least want to have sex with" partners in the pregnancy condition (M = .59 [SD = .40] vs. M = .71 [SD = .40], respectively), the STD contraction condition (M = .47 [SD = .42] vs. M = .64 [SD = .41], respectively), and the unknown outcome condition (M = .76 [SD = .36] vs. M = .84 [SD = .31], respectively). AUC values from the SPDT were significantly and positively correlated with one another (all p values < .01), with the exception of AUC values for the "least want to have sex with" partner in the STD contraction condition, which was not significantly correlated with any other SPDT condition.

Table 2 contains the means and standard deviations of study measures. To examine how AUC values on the SPDT relate to non-discounting study measures (i.e., STD-KQ, MFACS,

MCAS), correlational analyses were conducted. The resulting correlational matrix can be found in Table 3. Of note, AUC values for the "most want to have sex with" partner in the pregnancy condition (MS_PREG) were significantly and negatively correlated with the STD-KQ (r = -.32, p <. 05), and significantly and positively correlated with the MFACS (r = .29, p < .05). A significant negative correlation was also found between AUC values for the "most want to have sex with" partner in the STD contraction condition (MS_STD) and the STD-KQ (r = -.28, p < .05), as well as with the MFACS (r = -.43, p < .01). AUC values for the "least want to have sex with" partner condition in the STD condition (LS_STD) were significantly and positively correlated with the MCAS sub-scale for embarrassment with negotiation (r = .26, p < .05). AUC values for the "most want to have sex with" partner in the unknown outcome condition (MS_UNK) were significantly and negatively correlated with the MFACS (r = -.31, p < .05). Finally, a significant, negative correlation was observed between the MFACS and three MCAS sub-scales: reliability and effectiveness of condoms (r = -.28, p < .05), pleasure associated with condoms (r = -.42, p < .01), and stigma associated with condoms (r = -.51, p < .01).

Correlations between each item of the SRS and AUC scores for the SPDT are shown in Table 4. AUC scores for the "most want to have sex with" partner conditions in the pregnancy condition (MS_PREG) were significantly and negatively correlated with the following SRS items: "Hooked up but no sex" (r = -.28, p < .05) and "Unexpected sex" (r = -.32, p < .05). AUC values for the "least want to have sex with partner" partner for the pregnancy outcome condition (LS_PREG) were also significantly and negative correlated with the following SRS items: "Hooked up but no sex" (r = -.32, p < .05), "Unexpected sex" (r = -.28, p < .05), "Sex with new partner no discussion" (r = -.30, p < .05), and "Sex with a trusting partner" (r = -.29, p < .05).

AUC values for the "most want to have sex with" partner for the STD contraction condition (MS_STD) were significantly and negatively correlated with the following SRS items: "Sex with a new partner and no discussion" (r = -.30, p < .05), and "Sex with partner in open relationship" (r = -.27, p < .05). AUC values for the "most want to have sex with" partner for the unknown outcome condition (MS_UNK) were significantly and negatively correlated with the following SRS items: "Engaged in sexual behavior but not sex" (r = -.31, p < .05), "Left social event with a stranger" (r = -.30, p < .05), "Hooked up but no sex" (r = -.35, p < .01), "Left social event and had sex" (r = -.30, p < .05), "Unexpected sex" (r = -.32, p < .05), and "Sex under the influence" (r = -.26, p < .05). AUC values for the "least want to have sex with" partner for the unknown outcome condition (LS_UNK) were significantly and negatively correlated with the following SRS items: "Engaged in sexual behavior but not sex" (r = -.29, p < .05), "Left social event with a stranger" (r = -.35, p < .01), "Hooked up but no sex" (r = -.38, p < .01), "Left social event and had sex" (r = -.36, p < .01), and "Sex with a stranger" (r = -.33, p < .05).

Discussion

The present study sought to examine how the perceived negative outcomes of unprotected sexual intercourse influence hypothetical sexual decision-making. The present study demonstrated that by systematically decreasing the probability of a negative outcome (i.e., pregnancy, STD contraction, unknown), participants' likelihood of condom use also decreased. We also observed discounting differences across partner types, which was similar to findings of other SDDT and SPDT studies (e.g., Johnson & Bruner, 2012; Johnson & Bruner, 2013; Herrmann et al., 2014; Johnson et al., 2015; Johnson et al., 2016; Collado, Johnson, Loya, Johnson, & Yi, 2016; Johnson, Sweeney, Herrmann, & Johnson, 2016). Uniquely, this study adds to the literature the novel differences observed in discounting when the outcome of

unprotected sexual intercourse is manipulated. Collectively, these findings provide insights into risky sexual decision-making among college-aged individuals that can be used to guide potential prevention and intervention strategies.

Results of the SPDT revealed that partner desirability elicited significantly different responding, with greater discounting of condom-protected sex for the more desirable partner in all three outcome conditions. That is, participants were more likely to engage in risky, unprotected sexual intercourse when their hypothetical partner was more desirable. The tendency to favor unprotected sex with a more desirable partner is in alignment with the evolutionary principles of natural selection, and can potentially explain why unprotected sex would be considered acceptable when faced with the opportunity to procreate with an adaptive partner (Courtiol, Pettay, Jokela, Rotkirch, & Lummaa, 2012). Importantly, it is worth noting that the majority of participants in the present study were female (n = 52; 87.7%), and that discounting patterns may have been different for males. Ufortunately, an adequate comparison was not feasible with so few male participants in the total sample (n = 7; 12.3%). While a previous study found support for sex-related differences in delay discounting of condom-protected sex among college-aged individuals (i.e., men discounted condom-protected sex more steeply with more desirable partners compared to female participants; Collado et al., 2016), it remains unknown whether similar differences would be observed with probability discounting

Given a more equal distribution of male and female participants in the present study, it would have been possible to examine possible differences in the hypothetical likelihood of condom use in response to varying outcomes associated with unprotected intercourse. For instance, it is not unreasonable to speculate that female participants might discount condom-protected sex less steeply than male participants because women bear a relatively greater burden

associated with pregnancy. Interestingly, the results of the present study revealed greater discounting of condom-protected sex when the outcome was STD contraction compared to pregnancy. Such a difference at least suggests that pregnancy is perceived as being associated with relatively greater risk in a predominantly female sample. This finding is in line with the results of a study that found that, compared to male participants, female participants report more benefits of condom-protected sex and emphasize the costs of unprotected sex (Parsons, Halkitis, Bimbi, & Borkowski, 2000). Given the sampling issues of the present study, future research should address how sex differences influence probability discounting of condom-protected sex in response to differential risks in order to inform more targeted and effective prevention strategies for men and women.

Certain STDs are more serious than others in their short- and long-term health effects. For instance, chlamydia would not be as serious or detrimental as HIV (CDC, 2015). The results of the present study revealed that discounting of condom-protected sex was much steeper in the STD contraction condition relative to the other conditions involving potential pregnancy. One reason why this may have been the case may have been due to the fact that no explicit STD was described during the SPDT; instead, participants were forced to rely on their own operational definition of what constituted an STD. A qualitative, evaluative question was included at the end of the study which asked participants which STD they assumed was likely to be contracted if they did not use a condom. It is interesting to note that the same number of responses was recorded for chlamydia (23.7%) as for HIV (23.7%), indicating substantial variability in the severity and curability of the STDs that were considered as a potential consequence by participants. This variability in how participants define the STD in question may explain why likelihood of condom use was discounted most steeply in this condition. Future research could

use the SPDT to systematically compare the effects of STD type on the discounting of condom-protected sex.

When the outcome associated with unprotected sex in the SPDT was unknown, participants displayed very little discounting of condom-protected sex (i.e., high sensitivity to the unknown risks that were possible). These results may have been due to the order in which participants experienced the outcome conditions. While the presentation order of the pregnancy and STD contraction conditions was randomized, the unknown condition was always experienced last. This order may have resulted in some interference of the perception of risk and could have resulted in a hypersensitive reaction to ambiguous risk. As with the STD contraction condition, a qualitative, evaluative question was included which asked participants to indicate what they were considering most during the unknown outcome condition. Remarkably, an equal number of participants reported that they thought more of STD contraction compared to those who reported that they thought more of pregnancy (n = 24; 40.7%). Despite the instruction that only one of the two possible outcomes in the unknown condition would result from engagement in unprotected sex, 9 (15.3%) participants reported that they considered both pregnancy and STD contraction. These results highlight the fact that various outcomes of unprotected sex differentially influence hypothetical sexual decision-making across individuals.

To reduce high-risk sexual behavior among college-aged individuals, strategies often include improving knowledge for harm reduction and early interventions (Lindberg et al., 2016). However, the results of the present study revealed that a higher score on a measure assessing sexual risk knowledge (STD-KQ) was associated with a decreased AUC score for the "most want to have sex with" partner in the pregnancy and STD contraction conditions. This reveals that partner desirability may supersede sexual risk knowledge and be a more salient factor in

sexual decision-making. Despite the best intentions of sexual education programs, the relation between sexual health knowledge and sexual risk behavior should be examined more closely. Strikingly, within this study it appears that increased knowledge did not translate to an increased likelihood of engaging in safe, sexual decision-making but rather the opposite.

The SPDT has been used repeatedly as a measure of hypothetical sexual decision-making; however, due to the contrived nature of the task, it remains unclear if the results accurately reflect sexual risk behavior. To address this concern, correlations were examined between SPDT performance (AUC values) and items assessing instances of sexual behavior in the past six months (Sexual Risk Survey). All significant correlations between AUC values and individual items of the SRS were negative, suggesting that as the number of instances of self-reported sexual behavior increased, AUC values decreased (i.e., discounting of condom-protected sex was steeper). Higher scores on the SRS item "Hooked up but no sex" was associated with greater discounting of condom-protected sex in the "most want to have sex with" and "least want to have sex with" partner for both the pregnancy and the unknown outcome conditions. This result is potentially troubling given the fact that in a sample of 781 college students, 62% indicated that oral sex was not considered real sex (Dotson-Blake, Knox, & Zusman, 2012). According to the CDC (2017), oral sex can result in transmission of an STD from genitals to mouth, as well as mouth to genitals, and that STDs are often transmitted orally due to the absence of symptoms in the infected partner. Thus, prevention strategies aimed at increasing condom use among college students should emphasize not only the risks of vaginal and anal intercourse, but also those associated with oral sex.

The MFACS and the MCAS were significantly and negatively correlated. A higher score on the MFACS indicates a more negative view of condoms, and the opposite is true for each of

the five, independent sub-scales of the MCAS. This relation is encouraging because it confirms that both of the measures successfully identified condom attitudes, thereby providing concurrent validity for both measures. Condom attitudes were also related to SPDT performance. Specifically, a more negative view of condoms, as reflected by a higher score on the MFACS, was significantly and negatively correlated with greater discounting of condom-protected sex in the "most want to have sex with" partner in the STD contraction condition. Finally, a more negative view of condoms as related to pleasure assessed by the MCAS sub-scale was significantly associated with less discounting of condom-protected sex in the "most want to have sex with" partner in the pregnancy condition. However, this is likely due to the highly salient risk outcome of pregnancy for this sample. Many interventions seek to improve knowledge in order to reduce high-risk behavior; however, the results of this study indicate that changing attitudes related to safe sex behaviors may be a more efficient and targeted approach.

With each iteration of the SPDT, further evidence is gathered to support the notion that sexual decision-making can be altered by probability, partner characteristics, and the risk associated with unprotected sex. Future research should address how specific outcomes including pregnancy and STD contraction affect probability discounting across different groups (i.e., men, women, people in relationships, as well as members of the LGBTQA+ community). It would also be beneficial to explicitly define STDs in the SPDT and examine the likelihood of condom use with curable versus non-curable STDs to determine if the specific knowledge of an outcome results in greater or lesser discounting of condom-protected sex. Most notably, the unknown condition should be examined more closely to determine if the acute sensitivity to risk observed in the present study is dependent on the ambiguity of the condition, or if this is due to the order in which each risk outcome was experienced by the participant.

Another factor likely to affect condom use likelihood among college-aged individuals is substance use. Substance use is an important contextual factor that contributes to increased risky sexual behavior and subsequent negative outcomes (Ritchwood et al., 2015). Current research has begun to examine the role of substance use in discounting of condom-protected sex. For instance, research conducted by Johnson et al. (2016) administered varying doses of alcohol prior to completing the SPDT in a laboratory setting. Results indicated that participants showed a dose-dependent decrease in their sensitivity to the risk of contracting an STD (i.e., participants were more likely to have unprotected sex when intoxicated). Another study by Johnson et al. (2017) administered cocaine prior to completing the SPDT in a controlled research environment. Like the alcohol study, the results showed a diminished sensitivity to STD contraction risk when participants had been administered cocaine. Both of these studies, conducted with mostly young-adult participants, illustrate the unique relationship between substance use and sexual risk behavior. Given that these past studies have shown drug effects with the SPDT, it may be worth investigating drug effects in young adult users in this new version of the SPDT with manipulations of STD and pregnancy risk, as well as an unknown outcome resembling extra-laboratory settings.

A limitation of the present study involved the strict inclusion criteria. Specifically, we recruited only those individuals who were over the age of 18, single, comfortable answering questions about sex, had sex at least once in their lifetime, had unprotected sex at least once in their lifetime, were sexually active (i.e., have had sex at least once in the last 12 months), were not currently pregnant or trying to become pregnant, and did not have a current STD. However, it was the goal of this research to examine the probability discounting of condom-protected sex in individuals who were single but sexually active and therefore at greatest risk. The results of

this study were also limited by demographic characteristics, with the majority of participants being female. As a result, comparisons between males and females were not feasible. Another limitation was the contrived nature of the SPDT. However, since it would be unethical to conduct this study using real sexual situations with experiential outcomes of unprotected sex, it was determined that this hypothetical task was the best proxy to examine sexual decision-making. Another limitation of the SPDT was that participants' attention may have been taxed by multiple conditions. However, this is unlikely given the observation of partner and outcome differences across conditions. Finally, the order in which participants experienced the unknown outcome condition may also have been a limitation; prior exposure to both the pregnancy and STD contraction conditions may have influenced responding in the unknown outcome condition. Future research should address this potential order effect, as well as conduct meaningful comparisons of probability discounting of condom-protected sex between men and women.

Barring these limitations, the present study provides a more complex examination of how perceived outcomes influence hypothetical sexual decision-making. The results of this study also highlight how the relative salience for particular outcomes results in greater sensitivity to risk, and that increased knowledge of sexual risk does not necessarily translate to safe, sexual decision-making in a hypothetical situation. The addition of the manipulation of risk outcome in the present study provides a unique opportunity to examine hypothetical decision-making similar to real-life situations that likely influence sexual choices among college-aged individuals. Future research should extend this research by exploring the relationship between hypothetical sexual decision-making and other environmental factors the context of the sexual situation. Collectively, this research can provide a useful framework with which to develop targeted

interventions that seek to reduce high-risk sexual behavior and prevent the various negative outcomes that often accompany unprotected sexual behavior.

Ethics Statement

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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Figure Captions

Figure 1. *A sample probability curve illustrates the likelihood of a behavior in response to increasing odds against an outcome (i.e., contracting an STD).*

Figure 2. *Mean likelihood of condom use as a function of odds against an outcome (i.e., pregnancy, STD contraction, unknown outcome). Data from the "most want to have sex with" partner (circles) and "least want to have sex with" partner (squares) are accompanied by best fitting curves from a two-parameter hyperbolic discounting equation.*

Figure 3. *Mean AUC values for partner conditions (most/least want to have sex with) for each outcome condition (pregnancy, STD contraction, unknown outcome).*

Fig 1

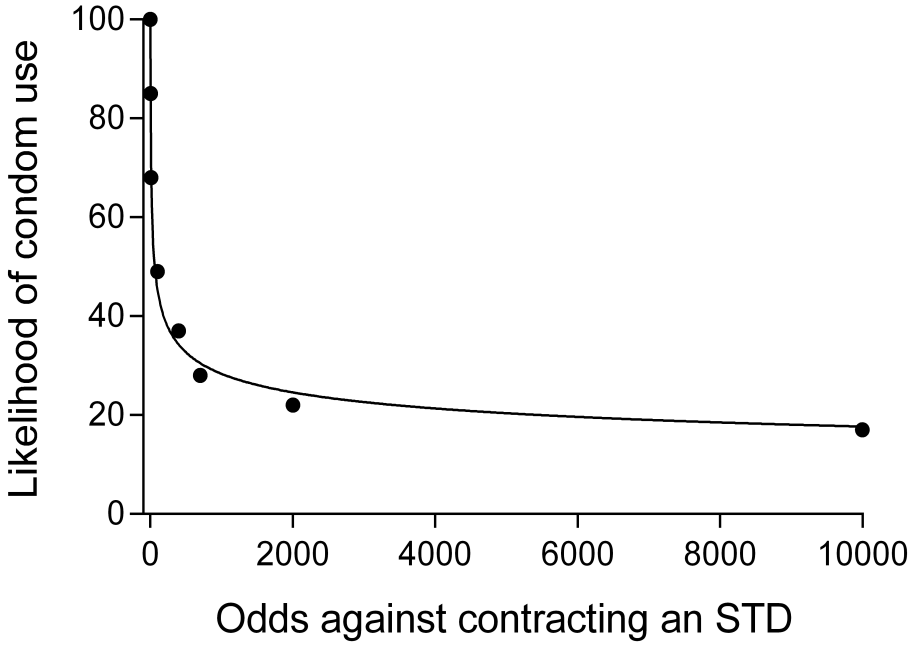
Likelihood of condom use
100
80
60
40
20
0
0
2000
4000
6000
8000
10000
Odds against contracting an STD

Fig 2

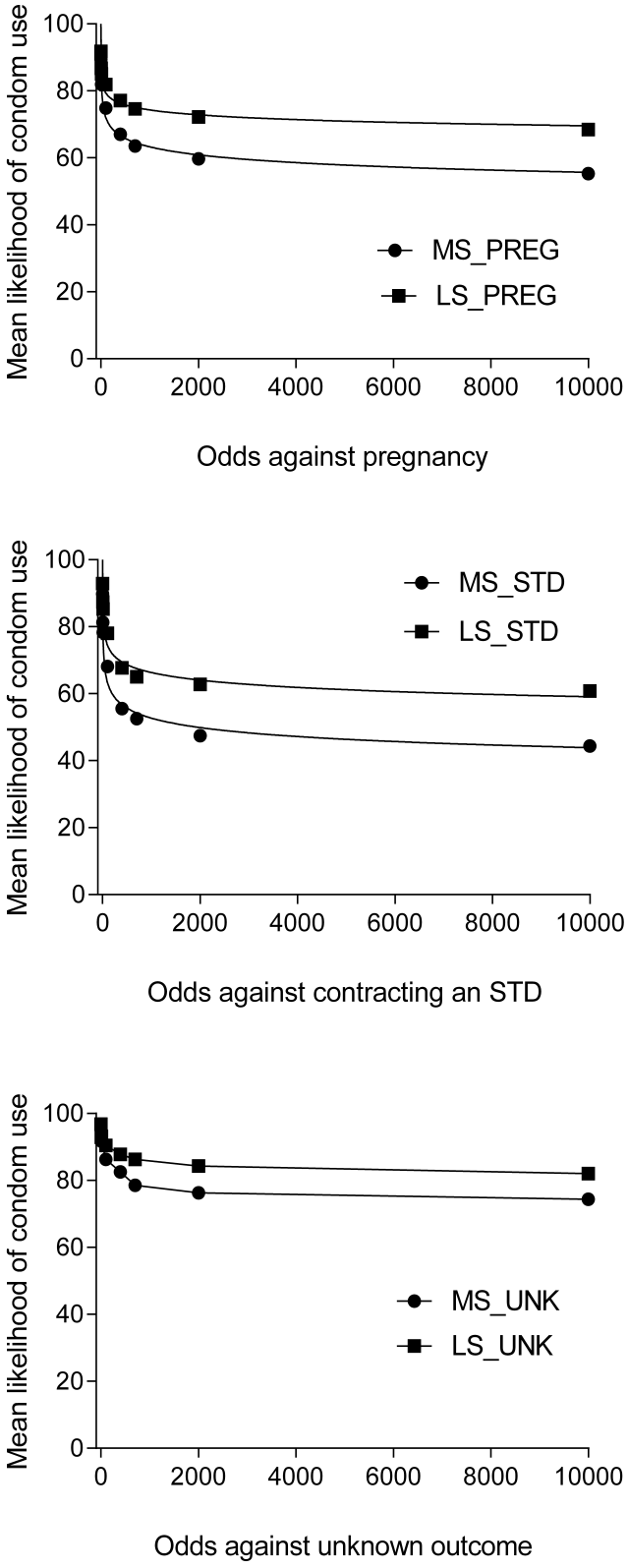
Mean likelihood of condom use
100
80
60
40
20
0
0
2000
4000
6000
8000
10000
MS_PREG
LS_PREG
Odds against pregnancy
Mean likelihood of condom use
MS_STD
LS_STD
Odds against contracting an STD
Mean likelihood of condom use
MS_UNK
LS_UNK
Odds against unknown outcome

Fig 3

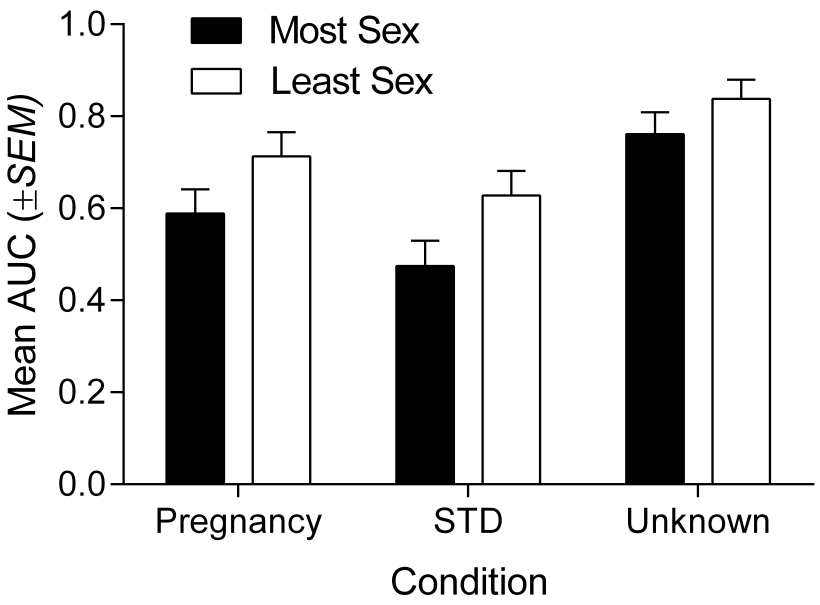
Most Sex
Least Sex
Mean AUC (±SEM)
1.0
0.8
0.6
0.4
0.2
0.0
Pregnancy
STD
Unknown
Condition

Table 1

Participant Demographic Information

n = 59	*Mean (SD)*	*n* (%)
Age, years	21.5 (5.2)	
Sex		
Male		7 (11.9)
Female		52 (88.1)
Race		
White/Caucasian		39 (66.1)
Asian		3 (5.1)
Hispanic or Latino/a/x		14 (23.7)
Native Hawaiian or other Pacific Islander		1 (1.7)
Prefer not to answer		1 (1.7)
Class Standing		
Freshmen		10 (17)
Sophomore		12 (20.3)
Junior		11 (18.6
Senior		24 (40.7)

Note: SD = Standard Deviation

Table 2

Means and Standard Deviations for Study Measures

Measures	*Mean* (*SD*)
STD-KQ	12.8 (7)
MFACS	47 (11.6)
MCAS	
Reliability and Effectiveness	23.9 (5.8)
Pleasure	16.4 (5.7)
Stigma	30.9 (5.1)
Embarrassment in Negotiation and Use	26.6 (4.7)
Embarrassment in Purchasing	22 (7.2)
Sexual Risk Survey	
Engaged in sexual behavior but not sex	5.3 (10.7)
Left social event with a stranger	1.4 (3)
Hooked up but no sex	2.7 (6)
Gone out with intent to hook up but no sex	2.6 (6.2)
Left social event and had sex	19.6 (132.2)
Unexpected sex	2.9 (4.2)
Sexual encounter later regret	1.5 (1.9)
Number of sexual partners	3.8 (4)
Engaged in vaginal sex no condom	17.2 (36.6)
Engaged in vaginal sex no birth control	3.4 (6.9)
Fellatio without protection	18 (32.9)
Cunnilingus without protection	8.1 (19.6)
Engaged in anal intercourse no condom	0.4 (1)
Anal fisting without protection	0.7 (2.7)
Analingus no protection	1.4 (5.6)
Friends with benefits	2.2 (2.9)
Sex with a stranger	1.5 (2.4)
Sex under the influence	11.8 (18.9)
Sex with a new partner and no discussion	3.4 (6.5)
Sex with a promiscuous partner	4.4 (13.8)
Sex with untested partner	1.1 (3.2)
Sex without trusting partner	1 (1.8)
Sex with partner in open relationship	1.5 (4.3)

Note: SD = Standard Deviation; STD_KQ = Sexually Transmitted Disease Knowledge Questionnaire; MFACS = Multifactorial Attitude Toward Condom Scale; MCAS = UCLA Multidimensional Condom Attitudes Scale.

Table 3
Pearson Correlation Coefficients on SPDT AUC Values and Study Measures

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. MS_PREG	-												
2. LS_PREG	.88**	-											
3. MS_STD	.45**	.47**	-										
4. LS_STD	-.07	-.01	-.01	-									
5. MS_UNK	.73**	.69**	.58**	-.12	-								
6. LS_UNK	.58**	.64**	.43**	-.13	.81**	-							
7. STD-KQ	-.32*	-.19	-.28*	.04	-.30*	-.12	-						
8. MFAC	-.17	-.15	-.43**	.08	-.31*	-.17	.10	-					
9. AGE	-.17	-.04	-.10	.07	-.24	-.26	.14	.01	-				
10. MCAS Reliability and Effectiveness	.14	-.05	-.06	-.20	.05	-.12	.02	-.28*	-.02	-			
11. MCAS Pleasure	.29*	.22	.20	-.08	.24	.15	-.11	-.42**	.04	.11	-		
12. MCAS Stigma	.22	.06	.24	-.22	.21	.05	-.06	-.41**	-.15	.55**	.26	-	
13. MCAS Embarrassment Negotiation	.09	-.06	.19	.26*	.17	.04	-.20	-.20	-.16	.23	-.00	.35**	-
14. MCAS Embarrassment Purchasing	-.23	-.22	-.01	.18	-.01	.02	.18	-.07	-.02	.00	.09	.05	.39

Note: AUC = Area Under Curve; SPDT = Sexual Probability Discounting Task; MS = Most Sex, LS = Least Sex; PREG = Pregnanc
STD = Sexually Transmitted Disease, UNK = Unknown; STD-KQ = Sexually Transmitted Disease Knowledge Questionnaire;
MFACS = Multifactorial Attitude Toward Condom Scale; MCAS = UCLA Multidimensional Condom Attitudes Scale.
* $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$.

Table 4
Correlation Coefficients Between Sexual Risk Survey and Likelihood of Condom Use

Item	MS_PREG	LS_PREG	MS_STD	LS_STD	MS_UNK	LS_UNK
1. Engaged in sexual behavior but not sex	-.15	-.20	-.20	-.13	-.31*	-.29*
2. Left social event with a stranger	-.19	-.24	-.19	-.10	-.26	-.35**
3. Hooked up but no sex	-.28*	-.32*	-.14	-.08	-.35**	-.38**
4. Gone out with intent to hook up but no sex	.03	-.02	.09	.06	-.02	-.06
5. Left social event and had sex	-.20	-.24	-.15	-.13	-.30*	-.36**
6. Unexpected sex	-.32*	-.28*	-.14	.12	-.32*	-.13
7. Sexual encounter later regret	-.13	-.19	-.07	-.10	-.26	-.20
8. Number of sexual partners	-.23	-.18	-.03	.23	-.13	-.22
9. Engaged in vaginal sex no condom	-.09	-.17	-.12	.02	-.22	-.10
10. Engaged in vaginal sex no birth control	-.18	-.24	-.12	.10	-.11	.09
11. Fellatio without protection	-.08	-.14	-.15	-.08	-.17	-.07
12. Cunnilingus no protection	-.03	-.04	-.10	.02	-.14	-.20
13. Engaged in anal intercourse no condom	-.14	-.05	.04	.12	-.04	-.08
14. Anal fisting without protection	.02	.10	-.15	.17	-.04	-.06
15. Analingus no protection	.05	.07	.15	.08	.03	-.02
16. Friends with benefits	-.17	-.16	-.07	.17	-.14	-.04
17. Sex with a stranger	-.11	-.18	-.20	.00	-.24	-.33*
18. Sex under the influence	-.14	-.18	-.16	-.10	-.26*	-.13
19. Sex with a new partner and no discussion	-.23	-.30*	-.30*	.08	-.22	-.10
20. Sex with promiscuous partner	.01	-.03	.06	.01	-.03	-.01
21. Sex with untested partner	-.18	-.22	.12	-.15	.05	-.02
22. Sex without trusting partner	-.25	-.29*	-.11	.03	-.23	-.06
23. Sex with partner in open relationship	-.20	-.26	-.27*	-.12	-.18	-.04

Note: Sexual Risk Survey N = 58; MS = Most Sex, LS = Least Sex; PREG = Pregnancy, STD = Sexually Transmitted Disease, UNK = Unknown;
* $p < 0.05$. ** $p < 0.01$.*** $p < 0.001$.