Archives of Sexual Behavior
https://doi.org/10.1007/s10508-019-1450-5

ORIGINAL PAPER

Delay Discounting of Protected Sex: Relationship Type and Sexual Orientation Influence Sexual Risk Behavior

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Received: 8 January 2018 / Revised: 1 April 2019 / Accepted: 2 April 2019

Abstract

Sexual discounting, which describes delay discounting of later protected sex vs. immediate unprotected sex (e.g., sex now without a condom vs. waiting an hour to have sex with a condom), is consistently linked to sexual risk behavior. Estimates suggest that over two-thirds of HIV transmissions occur between individuals in committed relationships, but current sexual discounting tasks examine sexual discounting only with hypothetical strangers, leaving a gap in our understanding of sexual discounting with committed sexual partners. We used the Sexual Discounting Task (SDT) to compare discounting rates between men who have sex with men (MSM; $n = 99$) and heterosexual men ($n = 144$) and tested a new SDT condition evaluating sexual discounting with main partners. MSM in committed relationships discounted protected sex with their main partner at higher rates than heterosexual men, and discounting rates correlated with self-report measures of condom use, impulsivity/sensation seeking, and substance use. These findings suggest that sexual discounting is a critical factor potentially related to increased HIV transmission between MSM in committed relationships and may be an important target for intervention and prevention.

Keywords HIV risk behavior · Delay discounting · Sexual discounting · Impulsivity · Sensation seeking

Introduction

The incidence of human immunodeficiency virus (HIV) among men who have sex with men (MSM) has remained steady in recent years despite a decline in incidence rates among the general population (CDC, 2017a). Consistent and correct condom use is one of the most effective methods for preventing sexually transmitted infections (STIs), including HIV (Weller & Beaty, 2002). However, consistent condom use has decreased significantly over the past decade among MSM (Paz-Bailey et al., 2016), which may help explain, in part, the unchanging HIV incidence among this population. Although antiretroviral therapies (ART) drastically improve life expectancy of individuals living with HIV/AIDS, delays in the initiation of treatment can worsen outcomes by reducing the medication's effectiveness, in turn reducing life expectancy (Samji et al., 2013). Therefore, an understanding of factors associated with condom use is necessary for early detection of HIV infection and preventing the spread of HIV and other STIs, particularly among MSM.

Delay discounting, a bias toward immediate, smaller rewards over delayed, larger rewards, has been linked with a wide range of adverse outcomes, including substance use, obesity, poor financial decisions, and sexual risk behavior (Beauchaine, Ben-David, & Sela, 2017; Bickel, Odum, & Madden, 1999; Johnson & Bruner, 2012; Rasmussen, Lawyer, & Reilly, 2010). Delay discounting is frequently measured using monetary incentives (e.g., a choice between $100 now and $1000 in a year). Findings linking monetary discounting to sexual risk behavior are mixed (Chesson et al., 2006; Jones & Sullivan, 2016; Lawyer & Mahoney, 2017; Thamotharan, Hahn, & Fields, 2017). In contrast, delay discounting tasks using sexual rewards are consistently linked to sexual risk behavior (Johnson & Bruner, 2012; Lawyer & Schoepflin, 2013; Mahoney & Lawyer, 2018; Thamotharan et al., 2017).

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Published online: 14 August 2019

Further, substance use is linked individually to both delay discounting and sexual risk behavior (Green & Feinstein, 2012; Halpern-Felsher, Millstein, & Ellen, 1996; Hayaki, Anderson, & Stein, 2006; Kollins, 2003; Thamotharan et al., 2017). Because MSM report high rates of substance use (Green & Feinstein, 2012; Hatzenbuehler, Corbin, & Fromme, 2008a; Semple, Zians, Grant, & Patterson, 2006), it is also important to consider the relationship between substance use and sexual discounting.

The Sexual Discounting Task (SDT; Johnson & Bruner, 2012) quantifies delay discounting of condom use with hypothetical sexual partners to predict sexual risk behavior, referred to here as sexual discounting. Individuals make choices about whether they would prefer to have sex immediately without a condom or to wait a specific amount of time (e.g., 1 h, 1 week) until they see the individual next and can have sex when a condom is available. If an individual has a steep sexual discounting rate, it indicates that they strongly prefer to immediately have sex without a condom than to wait until a condom is available. The SDT presents delay trials in four conditions with different hypothetical partners of differing desirability. Several studies with a variety of populations demonstrate that sexual discounting is predictive of self-reported sexual risk behavior, often more so than monetary discounting (Johnson & Bruner, 2012; Johnson, Johnson, Herrmann, & Sweeney, 2015; Jones et al., 2018; Mahoney & Lawyer, 2018; Thamotharan et al., 2017).

To date, only a few studies have examined sexual discounting among MSM (Herrmann, Johnson, & Johnson, 2015; Jones et al., 2018; Jones & Sullivan, 2016). Herrmann et al. (2015) found that a steeper discounting rate of condom-protected sex, indicating reduced likelihood of condom use with increasing delay in its availability, was linked with self-reported unprotected sex. In other words, participants indicated that the longer they had to wait to have sex with a condom, the more likely they were to have immediate, unprotected sex.

Although these studies provide insight into sexual decision-making processes of MSM, to our knowledge, no studies of sexual discounting among MSM have included heterosexual men as comparisons. Although MSM are at much higher risk for HIV and other STIs than heterosexual men, heterosexual men use condoms at similar rates and consistent condom use is low for both groups (Glick, Morris, Foxman, & Aral, 2012; Kort, Samsa, & McKellar, 2017; Pathela et al., 2011). It therefore remains unclear whether or not MSM have sexual discounting rates comparable to their heterosexual peers, or whether sexual discounting among MSM may contribute to additional HIV vulnerability, over-and-above other demographic characteristics.

One major limitation of the SDT is that it focuses only on sexual decision-making in the context of hypothetical, casual sex partners. Contrary to the traditional view that promiscuous and nonmonogamous relationships are the riskiest relationship types for contracting HIV and other STIs, estimates suggest that over two-thirds of all HIV transmissions between MSM in the U.S. occur in contexts of primary, committed relationships—not between casual sex partners (Sullivan, Salazar, Buchbinder, & Sanchez, 2009). In fact, many MSM view monogamous behavior as a protective factor against contraction of HIV and other STIs (Mustanski, Newcomb, Bois, Garcia, & Grov, 2011). The increased risk of HIV transmission between committed partners may be due to a number of reasons, such as serial monogamy (i.e., single committed partners in rapid succession) and incorrect assumptions about a partner's HIV status (Mustanski et al., 2011). Further increasing risk of HIV transmission between couples, individuals are more likely to have more unprotected sex with their primary partners than with casual partners (Misovich, Fisher, & Fisher, 1997; Mustanski et al., 2011). Although nonmonogamous relationships certainly remain risky for HIV/STI acquisition (Aral & Leichliter, 2010), there is a striking lack of focus within the literature, particularly in experimental research, on examining sexual risk behavior in the context of committed relationships (Parsons, Lelutiu-Weinberger, & Botsko, 2013). We seek to address this gap, in part, by adding a new condition to the SDT in which individuals make hypothetical decisions about condom use with their current sexual partner.

This study had three aims, including (1) to examine discounting rates between MSM and heterosexual men; (2) to validate a new condition for the SDT that examined discounting rates with a committed/primary partner, compared to a casual partner; and (3) to identify possible associations between performance on the SDT and self-reported sexual risk behavior, substance use, and personality characteristics (impulsivity, sensation seeking) that are often associated with risky decisions.

Hypothesis 1 We predicted, based on past findings of similar rates of condom use among heterosexual men vs. MSM (Glick et al., 2012; Kort et al., 2017; Pathela et al., 2011) and that there would be no significant differences in discounting rates between heterosexual men and MSM on the SDT.

Hypothesis 2 We predicted that participants would show steeper discounting rates for condom-protected sex with a main partner than with hypothetical partners.

Hypothesis 3 We predicted that individuals with steeper discounting rates would report more sexual risk behavior, substance use, and impulsivity/sensation seeking.

Method

All study procedures were approved by the local institutional review board, and informed consent was obtained from all participants.

Table 1 Participant demographics

	MSM		Heterosexual		Total	
	n	%	*n*	%	*n*	%
Sample size	99	40.7	144	59.3	243	
Race/ethnicity						
White	72	72.7	103	71.5	175	72
African American	9	9.1	2	1.4	11	4.5
Hispanic	7	7.1	6	4.2	13	5.3
Asian	9	9.1	28	19.4	37	15.2
Mixed race/other	2	2	5	3.5	7	2.8
Sexual orientation						
Heterosexual	0	0	144	100	144	59.3
Gay	50	50.5	0	0	50	20.6
Bisexual	49	49.5	0	0	49	20.1
Relationship status						
Single, not looking for a relationship	27	27.3	30	20.8	57	23.5
Single, casually dating	22	22.2	26	18.1	48	19.8
Dating, monogamous relationship	24	24.2	31	21.5	55	22.6
Open relationship	4	4	4	2.8	8	3.3
Married/partnered	21	21.2	53	36.8	74	30.5
	M	SD	*M*	SD	*M*	SD
Age (in years)	30.3	7.1	29.6	5.7	29.9	6.3

Participants

Participants were cisgender men ages 18 and older living in the U.S., recruited via Amazon Mechanical Turk (MTurk), an online platform with hundreds of thousands of users worldwide. MTurk allows users to complete human intelligence tasks (HITs) and other tasks for compensation. Participants were restricted to individuals living in the U.S. who self-reported as fluent English speakers and had at least 90% of past HITs approved (Shapiro, Chandler, & Mueller, 2013). MTurk is a cost-effective method for collecting large, diverse samples of difficult-to-reach populations such as MSM. It has previously been used to evaluate sexual discounting (Herrmann et al., 2015), and studies show that data collected using MTurk are valid, with clinical populations representative of the general population and with greater diversity than university samples (Buhrmester, Kwang, & Gosling, 2011; Shapiro et al., 2013).

Among participants who completed the study ($n = 249$), three were excluded due to changes in demographics between the pre-screening follow-up study (e.g., changes in sex/gender, sexual orientation and sexual behavior, changes in race/ethnicity, and/or changes in age) and three for failing three or more attention check questions designed to detect random responding, including items such as "click 'agree' for this question" and infrequency-type questions (e.g., answering "agree" or "strongly agree" to "most people enjoy a trip to the dentist"; Morey, 1991). This resulted in a final sample of 243, including 99 MSM (M age = 30.30 years, SD = 7.05) and 144 heterosexual men (M age = 29.56 years, SD = 5.68). Groups did not differ in age, $t(241) = 0.91$, $p = .36$. Most participants were Caucasian/White ($n = 175$, 72%), followed by Asian/Pacific Islander ($n = 37$, 15.2%), Hispanic/Latino ($n = 13$, 5.3%), African American/Black ($n = 11$, 4.5%), and mixed race/other ($n = 7$, 2.8%). Full demographic information is shown in Table 1.

Our sample size was based on a power analysis computed from effect sizes observed in past studies using the SDT that compared within-participants sexual discounting across condition types. These effect sizes range from small ($d = 0.19$) to large ($d = 0.76$) (Dariotis & Johnson, 2015; Johnson & Bruner, 2012; Thamotharan et al., 2017). The average effect size across these three studies was $d = 0.45$. To be conservative, we used an effect size of $d = 0.35$ in our power analysis, which we conducted in G*Power 3.1 (Faul, Erdfelder, Buchner, & Lang, 2009) with α set at .05 and power ($1 - \beta$) set at .80. This analysis indicated that a total sample size of 204 was required for between-group comparisons, and that 52 participants were required for within-subject comparisons.

Pre-screening

Individuals were paid between $0.10 and $0.25 to complete a pre-screening questionnaire assessing sexual orientation and other demographic information. The pre-screening survey was posted on MTurk with the title "Demographic Survey"

and participants were told that they may be invited to participate in a follow-up study based on their responses. Participants were not provided information about the nature of the follow-up study in the pre-screening questionnaire to ensure they would not change demographic information to qualify for the follow-up study.

The pre-screening questionnaire included items querying biological sex (male or female), sexual orientation (heterosexual/straight, gay or lesbian, bisexual, and other), and sexual behavior on a scale from 1 (exclusively heterosexual) to 7 (exclusively homosexual) and an additional point for "no prior sexual relationships."

Based on results from pre-screening, participants were divided into MSM and heterosexual groups. They were classified as heterosexual if they self-reported both heterosexual identity and exclusively heterosexual sexual behavior. Participants were classified as MSM if they self-identified as sexual minority and reported any same-sex sexual behavior. Participants who self-identified as a sexual minority and reported no prior sexual relationships ($n = 5$) were included in the sample. The groups were age-matched to avoid cohort effects. Individuals ($n = 471$) were contacted randomly from the list of eligible participants ($n = 664$) with information on how to access the follow-up study. The follow-up study took approximately 30–45 min to complete, and participants were compensated $5 for study completion.

Measures

Demographics

Demographics collected included sex, sexual orientation, age, race/ethnicity, and relationship status ("single, not looking for a relationship," "single, casually dating," "dating, in a monogamous relationship," "in an open relationship," "married/partnered").

Impulsivity and Sensation Seeking

The Barratt Impulsiveness Scale (BIS-11) was used to assess impulsivity (Patton, Stanford, & Barratt, 1995). This scale includes 30 items related to impulsivity rated on a Likert scale from 1 = Rarely/Never to 4 = Almost Always/Always (e.g., "I plan tasks carefully"). Scores range from 30 to 120, with higher scores indicating more impulsivity. The Sexual Sensation Seeking Scale (SSSS) is a 10-item scale used to assess sexual sensation seeking (Kalichman et al., 1994). Responses are rated on a Likert scale from 1 = "Not at all Like Me" to 4 = "Very Much Like Me" (e.g., "I am interested in trying out new sexual experiences"). Scores range from 10 to 40, and higher scores indicate greater sexual sensation seeking.

Drug Abuse Screening Test (DAST-10)

The 10-item DAST-10 was used for a general assessment of illicit drug use and substance use problems, excluding alcohol and tobacco use (Skinner, 1982; Yudko, Lozhkina, & Fouts, 2007). Responses were dichotomous (yes/no) to items, such as "Have you ever used drugs other than those required for medical reasons?" Total scores range from 0 to 10, with scores of 6 and higher indicating substantial drug abuse problems.

Alcohol Use Disorders Test (AUDIT)

The AUDIT (Saunders, Aasland, Babor, Delafuente, & Grant, 1993) was used to measure alcohol use problems. This scale consists of 10 items scored on 4-point Likert scales (e.g., "How often do you have a drink containing alcohol?"; "How often during the last year have you been unable to remember what happened the night before because of your drinking?"). Total scores range from 0 to 40. Participants who indicated that they have never had a drink containing alcohol were not shown the subsequent 9 items and were given a score of 0.

Substance Use History

Because the DAST-10 does not assess use of specific substances, an author-constructed survey was also included to broadly assess use of alcohol, cigarettes, marijuana, stimulants, and opioids. We did not assess for other drug classes (e.g., hallucinogens) in consideration of study length. For each substance, participants were asked if they had ever used the substance, if they had used it in the past year, and how much of the substance they typically use. If participants indicated that they never used a substance or had not used it in the past 12 months, they were not shown additional items related to that substance. A summed score was computed to include alcohol, marijuana, stimulant, and opioid use both in the past year and lifetime. Sum scores ranged from 0 (never used any substance) to 4 (used all four within the past year/lifetime).

Sexual Risk Behavior

Sexual risk behavior was assessed with several questions for which sex was defined strictly as vaginal or anal intercourse. Participants were asked whether or not they used a condom the last time they had sex (yes, no, or "I have never had sex"), condom use over the past 3 months and past year (on a 5-point Likert scale from "Always" through "Never" with a sixth point "I have not had sex in the past 3 months/year"); lower scores on these items indicate more consistent condom use. Participants were also asked if they have had anal sex in the

past 6 months (yes or no). Participants who indicated anal sex in the past 6 months were asked if any encounters involved unprotected anal intercourse (UAI) and if so, the number of instances. Next, participants were asked how many sexual partners they had both in the past year and over their lifetime. Participants were then asked whether they had an HIV test in the past 6 months and if they have used PrEP in the past 3 months. Participants also reported their current HIV status with choices: HIV positive; HIV negative; Unsure, but I think HIV positive; Unsure, but I think HIV negative; and I prefer not to respond. Participants were also asked to rate their likelihood of condom use if there were no chance of contracting HIV (on a scale from 0 to 100).

Relationship Status

Participants who indicated they were currently in a monogamous romantic or sexual relationship (yes or no) were asked how long they had been in this relationship (in months), the HIV status of their partner, and how often they use condoms with their romantic partner (0 indicating "never" through 100 indicating "always").

Sexual Discounting Task (SDT)

The SDT (Johnson & Bruner, 2012) was used to assess delay discounting of sexual rewards, including hypothetical opportunities to have sex with (1) an individual the participant most wants to have sex with ("Most Sex"), (2) an individual the participant least wants to have sex with ("Least Sex"), (3) an individual who is thought to be most likely to have an STI ("Most STI"), and (4) an individual who is thought to be least likely to have an STI ("Least STI"). We used, in part, the jsPsych JavaScript package to develop this task for presentation online (de Leeuw, 2015). For more detailed methods of this task, see Johnson and Bruner (2012).

From an album of 50 men and 50 women, participants selected individuals they would be willing to have sex with (Fig. 1a), and participants were able to select as few (minimum 2) or as many as they wished ($M = 22.45$, SD = 15.32). Out of the photographs selected, participants were asked to rate the individuals they most and least wanted to have sex with, as well as the individual they judged as most likely to have an STI and least likely to have an STI (Fig. 1b). The same individual could not be chosen for both the most and least sex conditions or most and least STI conditions. In contrast, the same individuals could be chosen for both the most/least of two different conditions (e.g., the same individual could be chosen as "most want to have sex with" and "least likely to have an STI"). For each of the chosen photographs,

Fig. 1 Sexual Discounting Task. **a** Participants choose individuals they would be willing to have sex with. **b** Participants make selections for (1) the individual they most want to have sex with, (2) least want to have sex with, (3) the individual judged most likely to have an STI, and (4) the individual judged least likely to have an STI. **c** Zero-delay trials are completed for each condition. **d** Delay trials are completed for each condition (seven trials with delays ranging from 1 h to 3 months)

participants completed the various SDT conditions, which were presented in random order within and between subjects.

Within each SDT condition, there were a total of 8 delay trials. Participants first completed the 0-delay trial (Fig. 1c) in which they rated on a 0–100 visual analogue scale how likely they would be to use a condom assuming one was readily and immediately available (0 = will definitely have sex without a condom; 100 = will definitely have sex with a condom). For the next 7 delay trials (Fig. 1d), which were presented from shortest delay to longest for all participants, participants were given the choice of having sex now without

a condom or waiting the specified delay (i.e., 1 h, 3 h, 6 h, 1 day, 1 week, 1 month, or 3 months) before they would see the person again and could have sex with a condom. For each delay, participants rated their likelihood of waiting to have sex with a condom from 0 = will definitely have sex now without a condom to 100 = will definitely wait to have sex with a condom.

Relationship Condition

As outlined above, we applied a new SDT condition, referred to here as the "Relationship" condition. Participants were asked: "Have you been in a monogamous sexual relationship with someone for at least the past 6 months; or, if you are in an open relationship/nonmonogamous relationship, is there someone who you have considered your main sexual partner for at least the past 6 months?" Participants who indicated yes were shown the additional SDT condition, which had an identical procedure to the original SDT conditions, except participants were asked to picture their main sexual partner while going through the delay trials.

Data Analysis

Analyses were conducted using R (R Development Core Team, 2018) and SPSS, version 24 (IBM Corp, Armonk, New York). Data characteristics of the SDT were examined using the algorithm described by Johnson and Bickel (2008). Ordinarily, discounting increases as a function of delay. The Johnson and Bickel algorithm categorizes a data point as nonsystematic if it is 20% or more greater than the previous point. In the context of the present task, this means that a data point was considered nonsystematic if a participant was over 20% more likely to report using a condom after a longer delay than the previous delay. This algorithm also recommends removal of participants who do not report any discounting with increasing delay, although this criterion is rarely used in sexual discounting tasks as there are individuals who likely commit to using condoms 100% of the time, regardless of delay, and was therefore not used in the present study (Johnson & Bruner, 2012; Thamotharan et al., 2017). Single nonsystematic data points in one condition were removed from analysis and replaced by the average of the two adjacent points (i.e., the choice from the delays immediately before and immediately after the nonsystematic point), as described by Dariotis and Johnson (2015). If two or more points were nonsystematic in a single condition, the participant's data were excluded for that condition only. Sample-wide, 104 data points from 50 participants were flagged as nonsystematic, consistent with data quality from past studies using the SDT (Dariotis & Johnson, 2015; Johnson & Bruner, 2012). Of these participants, most (34 participants) had only a single nonsystematic data point. Data were removed for participants who had two or more nonsystematic points in a single condition, including 5 individuals from the Least STI condition, 6 from the Least Sex condition, 9 from the Most STI condition, 11 from the Most Sex condition, and 1 from the Relationship condition.

In addition, individuals vary in the likelihood of using a condom when one is readily and immediately available, operationalized here as the participants' likelihood of using a condom on the 0-delay trial. To create a standardized value that isolates the effect of delay alone on sexual discounting, a standard value was computed by dividing a participant's likelihood of using a condom on a delay trial by the participant's 0-delay likelihood of using a condom (Johnson & Bruner, 2012). Participants who indicated a 0% likelihood of using a condom on the 0-delay trials were excluded from the standardization analysis but were retained in the analysis of 0-delay trials (Herrmann et al., 2015). In our sample, this included 17 individuals from the Least STI condition (7%); 9 from the Least Sex condition (3.7%); 1 from the Most STI condition (.4%); 20 from the Most Sex condition (8.2%); and 84 from the Relationship condition (53.2%). After standardization, area under the curve (AUC) values were computed for within- and between-group comparisons of discounting rates using the "pracma" R package (Borchers, 2017). For analysis, delay points were recoded to time in hours, and AUC values were determined by plotting the 8 delay values (0-delay up to 3-month delay) and calculating the area under these points. AUC values range from 0 to 1, and smaller values indicate steeper discounting rates or less likelihood of condom use with increasing delay.

In the 0-delay trial of the Relationship condition of the SDT, a high proportion (53.2%) of individuals reported a 0% likelihood of using a condom. Thus, we calculated both a standardized and nonstandardized value in the analysis of the Relationship condition of the SDT, as standardization would require removal of more than half of our sample. For between-group comparisons, both the standardized and the nonstandardized AUC values of the Relationship condition were used due to reduced sample size after removing participants during standardization. Furthermore, using only the standardized value for these analyses would not accurately reflect the reality of condom use with main partners demonstrated in our sample. A dichotomous variable was computed to classify participants who reported 0% likelihood of using a condom and those who reported any other likelihood of using a condom on the 0-delay trial in the Relationship condition.

Paired samples *t*-tests were used to compare within-subject performance on the SDT conditions: Most Sex, Least Sex, Most STI, Least STI, and Relationship. Independent samples *t*-tests were conducted to compare performance on SDT conditions between MSM and heterosexual men. Preplanned comparisons were conducted to compare within-subject conditions (AUC values of Most Sex vs. Least Sex, Most

STI vs. Least STI, Most Sex vs. Relationship, Least STI vs. Relationship) and between-subject conditions (AUC values of all 5 SDT conditions by sexual orientation). Although the sample size of the present study reduces effects of nonnormally distributed data on a *t* test (e.g., Boneau, 1960), we also conducted nonparametric tests in the case of nonnormally distributed data (Mann–Whitney *U* Tests for between-subject comparisons and Wilcoxon Signed Ranks Tests for within-subject comparisons). Where possible, Cohen's *d* was used as a measure of effect size. Correction for dependence between means was made for effect sizes reported with paired samples (Morris & DeShon, 2002). Pearson's correlations were used to examine relations between SDT performance and self-report measures, including HIV risk behavior, impulsivity, sensation seeking, and other psychological factors. Because groups were matched by age and did not vary on other important variables such as relationship length, covariates were not modeled for the main analyses. However, when comparing group differences on the Relationship condition, we did examine substance use as a potential covariate due to the relationship between delay discounting and substance use (Hayaki et al., 2006; Kollins, 2003; McKerchar & Renda, 2012).

Results

Zero-Delay Trials

On the 0-delay trials, participants indicated the likelihood of using an immediately and readily available condom with the partner chosen for each condition from 0 to 100. Means for these trials varied by condition, and the mean likelihood of condom use for the Most Sex partner condition ($M = 75.44$, $SD = 34.76$) was significantly less than mean condom use for the Least Sex partner condition ($M = 87.01$, $SD = 25.16$), $t(230) = 6.67$, $p < .001$, $d = 0.46$; $z = 6.82$, $p < .001$. Similarly, participants reported less likelihood of condom use on the 0-delay trial for partners in the Least STI condition ($M = 76.44$, $SD = 33.71$) compared to partners in the Most STI condition ($M = 91.92$, $SD = 19.0$), $t(233) = 8.21$, $p < .001$, $d = 0.60$; $z = 8.09$, $p < .001$. Participants who completed the Relationship condition were approximately 40% less likely to report using a condom with their current main sexual partner ($M = 34.07$, $SD = 43.97$) compared to the partner chosen as "most want to have sex with" in the Most Sex condition ($M = 75.44$, $SD = 34.76$), $t(154) = 11.14$, $p < .001$, $d = 0.90$; $z = 8.42$, $p < .001$.

To check if the finding in the Relationship condition was due to a large number of participants reporting 0% likelihood of using a condom with their main sex partner, we redid the analysis by only using participants who reported greater than 0 likelihood of using a condom with their main sex partner, which led to the same conclusion: Participants who completed the Relationship condition were significantly less likely to report using a condom with their current main sexual partner ($M = 72.34$, $SD = 36.45$) compared to the partner chosen as "most want to have sex with" in the Most Sex condition ($M = 87.27$, $SD = 26.53$), $t(72) = 3.71$, $p < .001$, $d = 0.45$; $z = 3.62$, $p < .001$.

Between-Subject Comparisons

Figure 2 shows sexual discounting between groups and conditions. AUC values were nonnormally distributed (Shapiro–Wilk's tests $ps < .001$). As a whole, participants showed significantly steeper discounting in the Most Sex partner condition ($M = .45$, $SD = .42$) compared to Least Sex ($M = .72$, $SD = .42$), $t(208) = 9.94$, $p < .001$, $d = 0.69$; $z = 9.74$, $p < .001$. Similarly, participants showed significantly steeper discounting in the Least STI partner condition compared to the Most STI partner condition, $t(215) = -8.95$, $p < .001$, $d = 0.63$; $z = 8.22$, $p < .001$. This finding indicates that individuals were less likely to use condoms with increasing delay for the individual they most want to have sex with and for the individual judged least likely to have an STI, respectively. There were no significant differences between groups on sexual discounting in these conditions, such that MSM and heterosexual men had comparable discounting rates for each of these four partner conditions, in line with Hypothesis 1.

Roughly two-thirds of participants reported being in a current sexual relationship with a main partner, including 61 MSM (61.6%) and 97 heterosexual men (67.4%), $\chi^2(1) = .85$, $p = .36$. On average, participants were in these relationships for 74.61 months ($SD = 64.80$), and there were no significant differences in length of relationships between MSM ($M = 78.24$, $SD = 77.45$) and heterosexual men ($M = 72.55$, $SD = 56.76$), $t(136) = 0.49$, $p = .62$. Many MSM (60.7%) and heterosexual participants (49.5%) reported 0% likelihood of condom use with their partner in the 0-delay trial of the Relationship SDT condition, with no significant difference between groups, $\chi^2(1) = 1.88$, $p = .17$.

In the Relationship condition, nonstandardized AUC values indicated that MSM ($M = .08$, $SD = .22$) discounted condom use at a steeper rate than heterosexual men ($M = .20$, $SD = .36$), $t(156) = -2.59$, $p = .01$, $d = 0.40$; Mann–Whitney U $p = .04$. This difference was also marginally significant when examining standardized AUC values, $t(55) = -1.96$, $p = .054$, $d = 0.47$; Mann–Whitney U $p = .054$. The finding shows that MSM were less likely to use condoms with main sexual partners compared to heterosexual men as a function of delay. There were no significant differences in any of the original SDT conditions between participants who were in a current relationship compared to those who were not (all p values $\geq .38$).

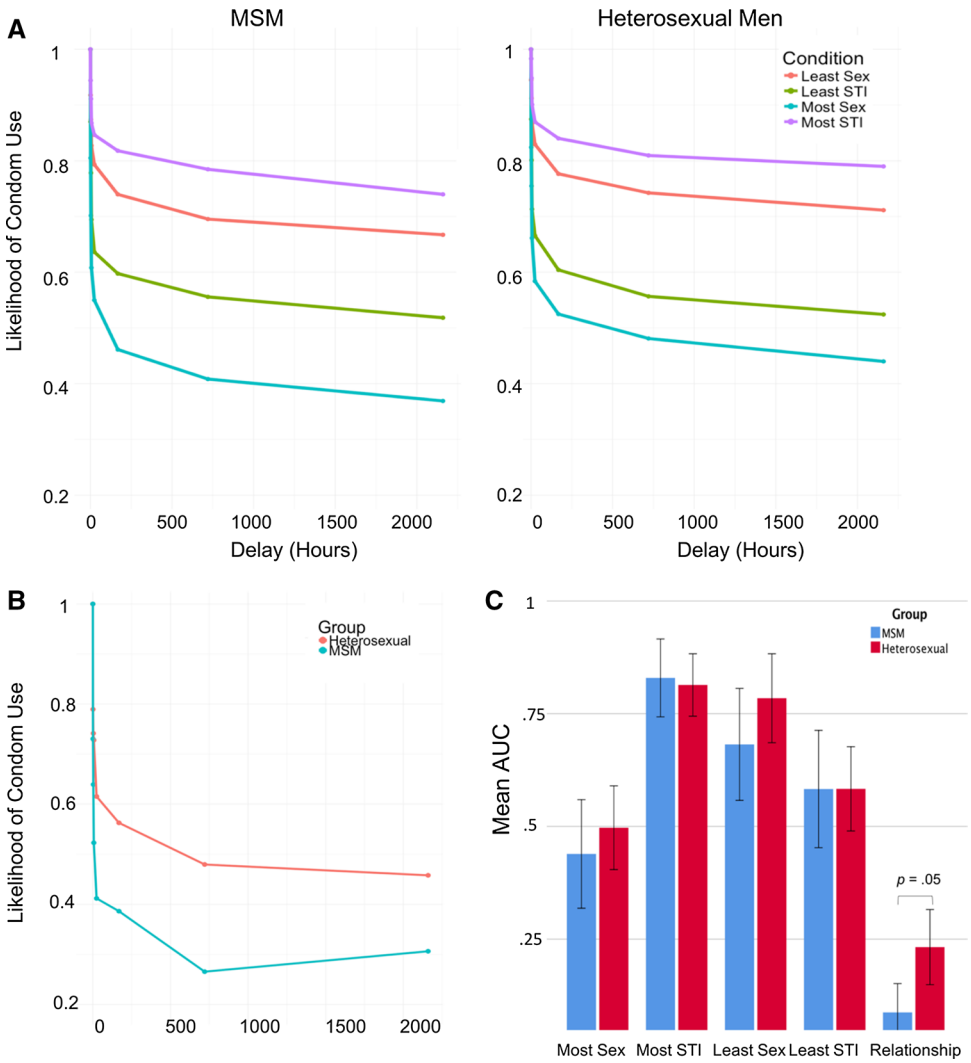

Fig. 2 **a** Sexual discounting for heterosexual men and MSM. Delay points are standardized mean choices for each of the 8 delay trials in each condition. **b** Sexual discounting for heterosexual men and MSM in the Relationship condition. Delay points are unstandardized mean choices for each of the 8 delay trials (see text for details). **c** Mean AUC values in each condition by group. Mean values are standardized for Most Sex, Most STI, Least Sex, and Least STI and are unstandardized for the Relationship condition; error bars represent 95% Confidence Interval

Within-Subject Comparisons of SDT Partner Conditions

We found that participants in a relationship showed steeper rates of discounting in the relationship condition compared to all casual partner conditions. When we used paired sample *t*-tests to examine within-participant differences between the Relationship condition and both the Most Sex and Least STI conditions, the Relationship condition showed the steepest discounting rates (compared to the original four SDT conditions), consistent with Hypothesis 2. Sample-wide, participants showed steeper discounting rates in the Relationship condition ($M = .17$, SD = .33) compared to the Most Sex condition ($M = .43$, SD = .41), $t(136) = -7.10$, $p < .001$, $d = 1.29$; $z = 8.11$, $p < .001$. The same was true when comparing discounting rates in the Relationship condition to the Least STI condition ($M = .56$, SD = .45), $t(144) = -10.10$, $p < .001$, $d = 0.86$; $z = 8.89$, $p < .001$. When repeating these analyses using the standardized AUC values in the Relationship condition, these findings remained significant such that individuals in the Relationship condition were still found to discount at steeper rates, $t(67) = -3.13$, $p = .003$, $d = 0.38$ and $t(72) = -4.64$, $p < .001$, $d = 0.54$; $z = 3.21$, $p < .001$, $z = 5.06$, $p < .001$ for the Most Sex and Least STI conditions, respectively. Although not fully reported here, these findings were consistent when split by group, $ps < .001$.

HIV Status, PrEP Use, and Sexual Behavior

No participants reported current use of PrEP for HIV prevention, and few received an HIV test in the past 6 months ($n = 36$, 14.8%). However, more MSM ($n = 23$, 23.2%) received an HIV test in the past 6 than months than heterosexual men ($n = 13$, 9.0%), $\chi^2(1) = 9.24$, $p = .002$. A total of 182 participants reported being HIV-seronegative, 54 reported being unsure but thought they were HIV-seronegative, and one participant reported being unsure but thought he was

HIV-seropositive. Two participants self-reported being HIV-seropositive and 3 participants declined to respond.

The number of reported lifetime sexual partners ranged from 0 to 300. MSM ($M = 24.92$, SD = 61.62) reported more lifetime sexual partners than heterosexual men ($M = 5.97$, SD = 7.46), $t(104.82) = 2.42$, $p < .001$, $d = 0.47$; Mann–Whitney U Test $p = .003$. Because there were a large number of outliers (those reporting ≥ 23 lifetime partners, $n = 29$), and since more MSM were outliers ($n = 22$, 22%) than heterosexual men ($n = 7$, 4.9%), $\chi^2(1) = 16.8$, $p < .001$, this analysis was repeated after a log transformation in an attempt to normalize the distribution without removing outliers. After log transformation, MSM continued to report significantly more lifetime partners ($M = .91$, SD = .60) compared to heterosexual men ($M = .66$, SD = .39), $t(155.86) = 3.56$, $p < .001$, $d = 0.49$. Similarly, MSM reported significantly more past-year sexual partners ($M = 2.06$, SD = 3.93) than heterosexual men ($M = 1.09$, SD = 0.87), $t(104.82) = 2.42$, $p = .002$, $d = 0.34$; Mann–Whitney U Test $p = .046$.

Condom Use

Among participants who ever had sex, 62% reported not using a condom during their last sexual experience. In fact, only 31.5% of MSM reported using a condom during their last sexual experience compared to 42.7% of heterosexual men, $\chi^2(1) = 2.89$, $p = .09$. MSM and heterosexual men did not differ in frequency of condom use either over the past 3 months or the past year, $t(221) = 0.94$, $p = .93$; $t(221) = 0.17$, $p = .87$, respectively. Sixty-one participants, 37 MSM (37%) and 24 heterosexuals (17%), reported unprotected anal intercourse in the past 6 months. These participants reported an average of 10.98 (SD = 17.75) instances of unprotected anal intercourse, which did not differ by group, $t(59) = 0.51$, $p = .61$.

Substance Use

On summed scores of lifetime substance use, MSM ($M = 1.85$, SD = 1.20) were more likely to report ever trying a greater number of substances compared to heterosexual men ($M = 1.36$, SD = 0.97), $t(241) = 2.42$, $p < .001$, $d = 0.45$. Compared to heterosexual men, MSM were more likely to report ever using marijuana, $\chi^2(1) = 11.40$, $p = .001$, OR = 1.56; stimulants (crack, cocaine, methamphetamine), $\chi^2(1) = 8.32$, $p = .004$, OR = 2.65; and opioids, $\chi^2(1) = 9.53$, $p = .002$, OR = 2.91. The groups did not differ significantly on the number of drinks per week or the number of cigarettes smoked per week, $t(175) = 0.39$, $p = .70$ and $t(65) = 0.44$, $p = .70$ for drinks per week and cigarettes per week, respectively. Similarly, compared to heterosexual men ($M = 1.01$, SD = 0.81), MSM ($M = 1.28$, SD = 0.96) were more likely to report using more substances over the past year, $t(241) = 3.49$, $p = .001$, $d = 0.33$, including cigarettes, $\chi^2(1) = 3.84$, $p = .050$, OR = 1.50; marijuana, $\chi^2(1) = 8.37$, $p = .004$, OR = 1.78; and opioids, $\chi^2(1) = 4.45$, $p = .03$, OR = 2.91.

In addition, we conducted an analysis of covariance to determine if the differences seen between MSM and heterosexual men in the Relationship condition of the SDT were driven by differences in substance use. When including the substance use combined score as a covariate, the difference between MSM and heterosexual men on the Relationship condition of the SDT was still significant, although with reduced effect size, $F(1, 155) = 3.77$, $p = .05$, partial $\eta^2 = .024$.

Associations Between SDT Performance and Self-Report Measures

HIV risk behavior. Figure 3 presents correlations between SDT conditions and HIV risk behavior. All conditions on the SDT were significantly and negatively correlated with condom use during participants' last sexual encounters, in line with Hypothesis 3. Thus, steeper discounting rates were associated with less condom use. The association between the SDT Relationship condition and condom use at last sexual encounter was especially strong, $r = -.62$, $p < .001$. In addition, frequency of condom use over the past year was correlated with the Least STI condition, $r(219) = -.17$, $p = .01$; the Most Sex condition, $r(210) = -.15$, $p = .03$; the Most STI, $r(231) = -.18$, $p = .01$; and the Relationship condition, $r(156) = -.59$, $p < .001$. Only the Most Sex condition was associated with the number of past-year sexual partners, $r(207) = -.15$, $p = .03$.

For participants who indicated a current monogamous sexual relationship, likelihood of condom use with this partner was associated positively with all SDT conditions, including Most Sex, $r(117) = .32$, $p < .001$ and Relationship, $r(129) = .60$, $p < .001$. Thus, steeper discounting rates were associated with less likelihood of condom use with partners.

We ran a multiple linear regression model to predict past-year condom use from SDT conditions (Most Sex, Least Sex, Most STI, Least STI, and Relationship), group, and the lifetime substance use summed score. Results showed that the model significantly predicted past-year condom use, $F(7, 120) = 9.96$, $p < .001$, $R^2 = .37$. The Relationship condition significantly predicted condom use, $\beta = -2.71$, $p < .001$, and no other individual predictors were significant.

Impulsivity and Sensation Seeking. Figure 3 shows overall patterns of correlations among variables. MSM and heterosexual men did not significantly differ on overall impulsivity, as measured by the BIS, although the difference approached significance, $t(241) = 1.92$, $p = .056$, $d = 0.25$. MSM ($M = 27.03$, SD = 6.45) reported greater sexual sensation seeking than heterosexual men ($M = 23.93$, SD = 6.53), $t(241) = 3.65$, $p < .001$, $d = 0.48$. However, impulsivity was slightly associated with sexual discounting only on the Most STI condition, $rs = -.13$, $p = .04$. In contrast, sexual

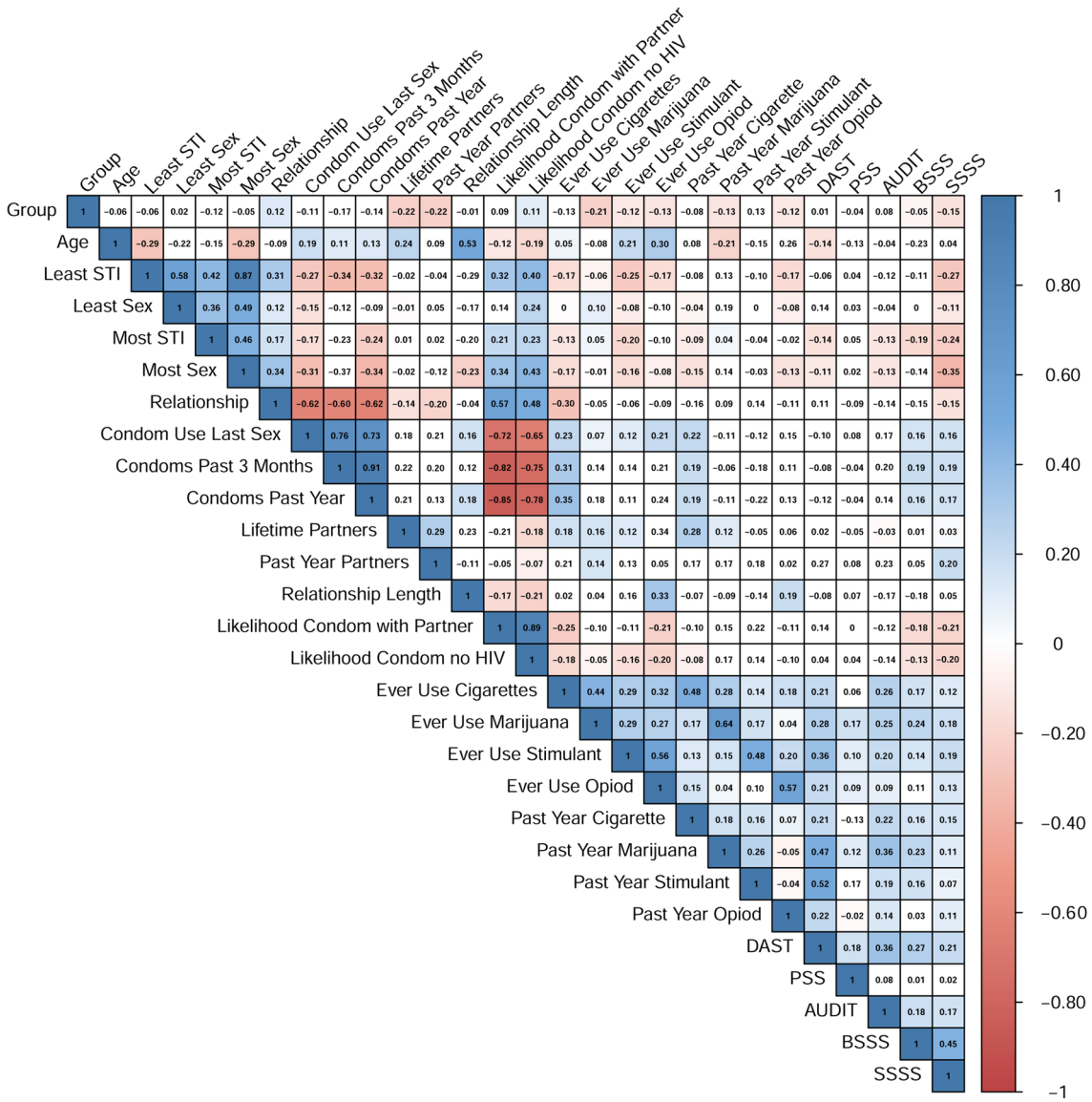

Fig. 3 Correlations between measures. Correlations that are significant ($p \leq .05$) are filled with blue (positive correlations) or red (negative correlations). Note: Group (1 = MSM, 2 = Heterosexual); Least STI, Least Sex, Most STI, Most Sex, and Relationship refer to AUC values from delay trials on each of the respective conditions of the Sexual Discounting Task (smaller values indicate less condom use with delay); Drug Abuse Screening Test (DAST); Alcohol Use Disorder Identification Test (AUDIT); Sexual Sensation Seeking Scale (SSSS); Past-Year Condom Use (1 = did not have sex in past year to 6 = never used condoms in past year)

sensation seeking was associated with all conditions of the SDT, including the Relationship condition, all $rs \geq -.11$, all $ps \leq .05$.

Impulsivity was not associated with condom use, $rs \leq .035$, $ps \geq .57$. However, sexual sensation seeking was correlated with condom use on the last sexual experience, $r(241) = .33$, $p < .001$, such that higher sexual sensation seeking indicated less likelihood of condom use. Similar associations were found between sexual sensation seeking for past 3 month and past-year condom use (see Fig. 3). Finally, only sexual sensation seeking was associated with the number of lifetime and past-year partners, $r(237) = .14$, $p = .03$ and $r(238) = .19$, $p = .004$, respectively.

Discussion

To the best of our knowledge, this is the both first study to compare sexual discounting rates between MSM and heterosexual men and the first to examine sexual discounting with primary/committed sexual partners. MSM and heterosexual men did not differ significantly in discounting rates vis-à-vis casual sex partners, in line with Hypothesis 1. This suggests that both groups make similar decisions regarding condom use with casual sex partners, consistent with previous self-report studies (Glick et al., 2012; Kort et al., 2017). However, compared to heterosexual men, MSM showed steeper discounting rates with their primary partners, with a medium effect size. This finding highlights the importance of understanding condom use in the context of main partnerships/steady relationships compared to casual sex partners among MSM. Because this is the first study to examine sexual discounting in the context of primary/committed partnerships, little is known about effects of delay on condom use with such partners.

Committed sex partners are perceived as lower-risk than casual sex partners (Mehrotra, Noar, Zimmerman, & Palmgreen, 2009). Studies consistently show that individuals are both less likely to use condoms with primary/committed partners than casual partners and are more likely to engage in other HIV risk behaviors with primary/committed partners, such as substance use before sex (Kapadia, Latka, Hudson, & Golub, 2007; Lansky, Thomas, & Earp, 1998; Lescano, Vazquez, Brown, & Litvin, 2006). Confirming Hypothesis 2, our study is the first to demonstrate this relationship experimentally. Notably, this finding remained consistent even after removing half of the sample when standardizing AUC values, as described above. When considering potential implications of our findings, it is important to note that no participants reported current use of PrEP. Thus, all HIV-seronegative participants were at potential risk for HIV contraction.

Findings from SDT conditions–including our new Relationship condition–demonstrated sensitivity to different partner conditions matching real-world scenarios, consistent with previous findings of studies using the SDT (Dariotis & Johnson, 2015; Herrmann et al., 2015; Johnson & Bruner, 2012; Thamotharan et al., 2017). Participants were less likely to use condoms as delays increased for partners who they most wanted to have sex with compared to least wanted to have sex with, and for partners judged least likely to have an STI compared to partners judged most likely to have an STI. These findings demonstrate the sensitivity of the SDT to real-world experiences influencing risk perceptions, with individuals reporting less likelihood of condom use with delay for partners deemed more desirable or less risky, consistent with numerous self-report and correlational findings (Gerrard, Gibbons, & Bushman, 1996; Mehrotra et al., 2009; Misovich et al., 1997; Sheeran & Taylor, 1999).

Sample-wide rates of consistent condom use were low, and over a third of MSM reported unprotected anal intercourse in the past 6 months. In addition, individuals in primary relationships may be at high risk for the contraction of HIV and other STIs as over 50% of individuals currently in a primary sexual relationship reported they would not use a condom with this partner even if one were readily available. Even individuals who would use a condom with their primary/committed partner if it were available demonstrated less condom use with this partner compared to hypothetical partners as delay increased. Although some would be willing to use a condom if it were available, having to wait even as little as 1 h greatly reduced the likelihood of condom use. This may provide insight into why a large proportion of HIV transmissions occur between individuals in committed relationships (Sullivan et al., 2009). Importantly, participants who reported any likelihood of using a condom with their primary/committed sex partner were 75% likely to use one, on average.

MSM reported significantly higher usage rates of many substances, including stimulants, opioids, and marijuana. MSM reported relatively high rates of ever using stimulants and opioids, with 20% indicating they have ever used stimulants and 20% indicating they have ever used opioids, compared to approximately 8% of heterosexuals. These findings are consistent with a large body of literature demonstrating increased rates of substance use and substance use disorders experienced by MSM and other sexual minorities (Green & Feinstein, 2012; Hatzenbuehler, Nolen-Hoeksema, & Erickson, 2008b; Hughes & Eliason, 2002; Marshal et al., 2008; Woody et al., 2001), findings that are often attributed in part to minority stress (Hatzenbuehler et al., 2008a, b; McCabe, Bostwick, Hughes, West, & Boyd, 2011; Meyer, 2003). Of note, substance use was correlated with both discounting rates on the SDT and self-reported condom use. Substance use, and particularly substance use before sex, are consistent predictors of HIV risk behavior (Hirshfield, Remien, Humberstone, Walavalkar, & Chiasson, 2004; Holloway, Pulsipher, Gibbs, Barman-Adhikari, & Rice, 2015; Patterson, 2005; Semple et al., 2006). However, despite the increased substance use demonstrated by MSM, the significant difference in SDT performance on the Relationship condition between MSM and heterosexual men remained even after controlling for substance use.

In addition, in line with Hypothesis 3, performance on the SDT was associated with self-reported impulsivity and sensation seeking, especially sexual sensation seeking. Impulsivity and sensation seeking are among the most well-studied personality and trait-level psychological factors associated with sexual risk behavior (Charnigo et al., 2013; Donohew et al., 2000; Jones & Sullivan, 2014; Mustanski et al., 2011). Our study demonstrates validity of the SDT as a behavioral

measure of sensation seeking related to sexual rewards. Importantly, the BIS, which is a broad, nondomain specific measure of impulsivity, was generally unrelated to outcomes. In contrast, sexual sensation seeking, which is a more focused measure of impulsivity in the context of sexual relationships, demonstrated strong associations across measures. This provides additional support for the use of commodity-specific delay discounting tasks like the SDT for measuring outcomes such as sexual risk behavior.

There were several limitations to note in the present study. First, our sample was limited by low numbers of racial and ethnic minorities. Because Black and Latino MSM are at particularly high risk for HIV contraction, future studies should focus on these groups to determine if the present findings hold true with a more diverse sample. Similarly, our study did not include transgender women or other gender nonconforming participants, and transwomen–particularly Black and Latina transwomen–are at similarly high risk for HIV contraction (CDC, 2017b). In addition, this study relied on self-reported sexual risk behavior and condom use, which may limit these findings. However, the behavioral data showed quality at similar or better rates than past studies of the SDT (Dariotis & Johnson, 2015; Johnson & Bruner, 2012). Finally, the large number of individuals who reported a 0% likelihood of using a condom with their main partner, even if one was available, make it difficult to isolate the effects of delay on condom use with a partner. Further, because the majority of participants would not use condoms with a main partner, other sexual discounting tasks that do not examine discounting of condom use may be more appropriate for this sample. Future studies should also consider the loss of sample size in the Relationship condition after removing participants who report 0% likelihood of condom use on 0-delay trials when determining power.

Despite these limitations, our findings clearly elucidate sexual discounting within the context of a primary relationship as an important variable in explaining the decreased use of condoms with primary partners and the increased rates of HIV transmission in this context. While this relationship was true for both MSM and heterosexual men, MSM, due to both their inherently increased risk of HIV contraction and the decreased use of condoms with delay compared to heterosexual men, are a particularly important population to target for prevention and intervention strategies. Future work can expand on the present findings to further characterize individuals at high risk for HIV contraction due to inconsistent or no condom use.

Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical Approval 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.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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