Sexual Discounting of Condom Use with Delay by Men: Implications of Relationship Status and Sexual Orientation

THESIS

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By

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Abstract

Men who have sex with men (MSM) experience the highest rates of HIV infection in the United States. Sexual risk behaviors arise in part from delay discounting (i.e., under-valuing) of later protected sex vs. immediate unprotected sex—a phenomenon known as sexual discounting (e.g., unprotected sex now or sex with a condom after a delay of 1 hour). To date, however, no studies have compared sexual discounting between MSM and heterosexual men, so it is unknown whether these groups make decisions regarding safe sex in similar or different ways. In addition, estimates suggest that over two thirds of HIV transmissions occur between individuals in committed relationships, who, given increased trust, reduce condom use and engage in more frequent sexual interactions. Critically, current sexual discounting tasks examine sexual discounting only with hypothetical strangers, leaving a large gap in our understanding of sexual discounting with committed/primary sexual partners. We used the Sexual Discounting Task (SDT) to (1) compare sexual discounting rates between MSM (n=99) and heterosexual men (n=144), and (2) pilot and validate a new SDT condition to evaluate sexual discounting of condom use with romantic partners as opposed to hypothetical strangers. Discounting correlated with self-report measures of sexual risk behavior, substance use, and impulsivity. No differences between MSM and heterosexual men emerged in the original
conditions of the SDT. However, MSM in committed relationships discounted protected sex at higher rates than heterosexual men when considering sex with their current romantic partner. These findings suggest a possible mechanism of increased HIV transmission between MSM in committed relationships and highlight a critical target for intervention.
Dedication

Thank you to my advisors, Drs. Ahn and Beauchaine, for the encouragement, advice, and drive to produce meaningful and high-quality research, and to Dr. Way for your willingness to serve on my committee. Thank you to Dr. Thamotharan for your years of support and for your help in designing this project. I could not have completed this project without the valuable assistance of Samuel Kalnitsky, who converted the study to work online, and Nathaniel Haines. Thank you as well to my friends and family for their support throughout my graduate education.
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Fields of Study

Major Field: Psychology

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Chapter 1: Introduction

The incidence of human immunodeficiency virus (HIV) among men who have sex with men (MSM) has increased by 6% in the past decade despite a nearly 20% decrease in the general population (Centers for Disease Control and Prevention [CDC], 2017a). Young MSM (ages 13-24 years) are at particularly high risk (CDC, 2017b). According to the same report, young MSM are also least likely to get tested for HIV and least likely to get proper care if diagnosed as HIV seropositive compared to older MSM. Consistent condom use is one of the most effective methods for preventing sexually transmitted infections (STIs), including HIV (Weller & Beaty, 2002). Critically, consistent condom use among MSM has decreased significantly over the past decade (Paz-Bailey et al., 2016), which, despite recent breakthroughs in HIV prevention methods such as pre-exposure prophylaxis (PrEP), may explain the growing rates of HIV and other STIs among this population. In addition, although antiretroviral medications and other treatments for HIV have drastically increased life expectancy and quality of life for individuals living with HIV/AIDS, delays in treatment can worsen outcomes (Samji et al., 2013). Therefore, an understanding of factors associated with condom use is necessary for early detection of HIV infection and preventing
spread of HIV and other STIs, particularly among MSM.

Delay discounting, a bias toward immediate, smaller rewards over delayed, larger rewards, is closely linked with a wide range of adverse outcomes, including substance use, obesity, poor financial decisions, and high-risk sexual behavior (Beauchaine, Ben-David, & Sela, 2017; Bickel, Odum, & Madden, 1999; M. W. Johnson & Bruner, 2012; MacKillop et al., 2011; Rasmussen, Lawyer, & Reilly, 2010). Delay discounting is often viewed as a behavioral measure of impulsivity, and is consistently linked with HIV risk behavior (Jones & Sullivan, 2014). Although delay discounting is frequently measured using monetary incentives, other commodities are often more predictive of specific outcomes such as substance use and sexual risk behavior (Bickel et al., 1999; Johnson & Bruner, 2012; Rasmussen et al., 2010; Thamotharan, Hahn, & Fields, 2017).

The Sexual Discounting Task (SDT; Johnson & Bruner, 2012) quantifies delay discounting of condom use with hypothetical sexual partners to predict sexual risk behavior. Individuals make choices about whether they would prefer to have sex immediately without a condom or wait a specific amount of time (e.g., 1 hour, 1 week) until they see the individual next and can have sex when a condom is available. The SDT presents delay trials in four conditions with different hypothetical partners, including the person who the individual (a) most wants to have sex with, (b) least wants to have sex with, (c) judges as most likely to have an STI, and (d) judges as least likely to have an STI. Several studies with
a variety of populations demonstrate that the SDT is more predictive of self-reported sexual risk behavior than traditional monetary discounting tasks (e.g., Johnson & Bruner, 2012; Thamotharan, Hahn, & Fields, 2017). In addition, the SDT shows strong test-retest reliability among cocaine-dependent adults (Johnson & Bruner, 2013).

To date, only three studies have examined delay discounting of any kind among MSM, and only one has examined sexual discounting. Herrmann and colleagues (2015) found that steeper discounting rates of condom-protected sex were linked with self-reported unprotected sex. In addition, discounting rates were steepest with partners the individual most wanted to have sex with and judged least likely to have an STI, highlighting the sensitivity of the measure to real-world scenarios. Thus, 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, particularly for individuals judged as more desirable.

Although these studies provide insight into the decision-making process of MSM, no studies of delay discounting among MSM have included heterosexual men as comparisons. It is therefore difficult to determine whether or not delay discounting could be a potential mechanism driving the disparities in health outcomes (e.g., substance use, sexual risk behavior) experienced by MSM, or if these groups make decisions about protected sex in similar ways. Although MSM are at much higher risk for HIV and other STIs than heterosexual men, heterosexual men use condoms at similar or even lower rates, though 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 discounting rates comparable to their heterosexual peers, or whether delay discounting among MSM may contribute to additional HIV vulnerability, over-and-above other demographic characteristics.

Furthermore, 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 promiscuity and non-monogamy are the most risky 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 steady 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). Unfortunately, around half of MSM are unaware of their HIV status (Mustanski et al., 2011), and the CDC estimates that half of HIV-seropositive young MSM are unaware of their infection (CDC, 2017c). Further increasing risk of HIV transmission within couples, individuals are more likely to have both unprotected sex and more sex with their primary partners than with casual partners (Misovich, Fisher, & Fisher, 1997; Mustanski et al., 2011). Such decisions are based on a variety of factors, including increased trust between primary partners and the assumption that their partner’s HIV status is negative, among others (for a review, see Mustanski et al.,
Although non-monogamous 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). In this study, we seek to address this gap, in part, by adding a new condition to the SDT in which individuals imagine their current romantic partner as the hypothetical sex partner.

In conducting the study, we had three aims, including (1) to examine discounting rates between MSM and heterosexual men; (2) to validate a new condition for the SDT that examines 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. We hypothesized, based on past findings of similar or lower rates of condom use among heterosexual vs. MSM (Glick et al., 2012; Kort et al., 2017; Pathela et al., 2011), that heterosexual men would show similar or steeper discounting rates on the SDT compared to MSM. We also hypothesized that participants would show steeper discounting rates for condom-protected sex with a main partner than with hypothetical partners. Finally, we hypothesized that individuals with steeper discounting rates would report more sexual risk behavior, substance use, and impulsivity/sensation seeking.
Chapter 2: Method

All study procedures were approved by the local institutional review board, and informed consent was obtained from all 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 task 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. MTurk is a cost-effective method for collecting large, diverse samples of difficult-to-reach populations such as MSM. It has been used to evaluate sexual discounting (Herrmann, Johnson, & Johnson, 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, Chandler, & Mueller, 2013).

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 $\alpha$ set at .05 and power ($1-\beta$) set at .80. This analysis indicated a total sample size of 204 was required for between-groups 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 in order 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 an 8-point 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 were contacted randomly from the list of eligible participants 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.

Participants

Among participants who completed the study ($N = 249$), 6 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) or for failing attention check questions designed to detect random responding. This resulted in a final sample of 243, including 99 MSM (mean age = 30.30, $SD = 7.05$) and 144 heterosexual men (mean age = 29.56, $SD = 5.68$). 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 presented in Table 1.

<table>
<thead>
<tr>
<th></th>
<th>MSM</th>
<th>Heterosexual</th>
<th>Total</th>
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<tr>
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<td>144</td>
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<tr>
<td>Race/Ethnicity</td>
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<tr>
<td>White</td>
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<td>103</td>
<td>175</td>
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<tr>
<td>African American</td>
<td>9</td>
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<td>11</td>
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<tr>
<td>Hispanic</td>
<td>7</td>
<td>6</td>
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<tr>
<td>Asian</td>
<td>9</td>
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*Table 1. Participant demographics*
### Table 1. Participant demographics

<table>
<thead>
<tr>
<th>Demographics</th>
<th>M</th>
<th>S.D.</th>
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<th>M</th>
<th>S.D.</th>
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<td></td>
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<tr>
<td>Female</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sexual Orientation</td>
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<td></td>
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<tr>
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<td>144</td>
<td>100</td>
<td>144</td>
<td>59.3</td>
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<td>50</td>
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<td>49</td>
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<td></td>
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<tr>
<td>Single, not looking</td>
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<td>30</td>
<td>57</td>
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<td>Single, casually</td>
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<td>26</td>
<td>48</td>
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<td></td>
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<tr>
<td>Dating, monogamous</td>
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<td>31</td>
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<tr>
<td>Open Relationship</td>
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<td>4</td>
<td>8</td>
<td>3.3</td>
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<tr>
<td>Married/Partnered</td>
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<td>53</td>
<td>74</td>
<td>30.5</td>
<td></td>
<td></td>
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<tr>
<td>Age</td>
<td>30.3</td>
<td>29.6</td>
<td>29.9</td>
<td>6.3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Measures**

Demographics. Demographics collected included sex, sexual orientation, age, race/ethnicity, past sexual behavior, and gender (see above), as well as highest level of education completed, relationship status (“single, not looking for a relationship,” “single, casually dating,” “dating, in a monogamous relationship,” “in an open relationship,” “married/partnered.”)

**Barratt Impulsiveness Scale (BIS-11).** The BIS-11 is a widely used self-report measure assessing trait 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. 

Drug Abuse Screening Test (DAST-10). The 10-item DAST-10 (original citation) 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 are 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 6 and higher indicating substantial drug abuse problems.

Alcohol Use Disorders Test (AUDIT). The Audit (Saunders, Aasland, Babor, De la Fuente, & 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 specific substances, an author-constructed survey was also included to broadly assess substance use for cigarettes, marijuana, stimulants, and opioids. For each substance, participants were asked if they had ever used, if they had used in the past year, how much of the substance they typically use, if the substance has caused them problems in the past 12 months, and if anyone had objected to their use in the past 12 months. For opioids, participants were asked if the substance was prescribed by a medical professional and if so, was it used
exactly as prescribed. 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 4 within the past year).

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 6 point Likert scale from Always through Never and “I have not had sex in the past 3 months/year”); note: lower scores on this scale 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. Current use of pre-exposure prophylaxis (PrEP) to prevent HIV infection was assessed with the question: “Have you taken anti-HIV medications in the past three months (sometimes called PrEP, Truvada, ‘taking a T’ or using the 3 Vs)?” 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 in months they had been in this relationship, 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 (Johnson & Bruner, 2012), 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”). Participants were instructed that they would be asked hypothetical questions about their willingness to have sex in various situations. They were instructed that if they were currently in a relationship, to pretend that they were “single and available” and would not cheat on anyone by indicating they would have sex with somebody in the task. Participants then were asked whether they would like to choose pictures of individuals they would like to have sex with from pictures of men, women, or both. Next, participants were instructed to pick individuals they would be willing to have sex with based on physical appearance alone; that is, they were asked to assume that the individual had any personality traits or other characteristics necessary to be found sexually attractive. Headshots of individuals of diverse race/ethnicities, weight, and attractiveness (50 men and/or 50 women) were then displayed based on participants’ preferences.
Participants then selected individuals they would be willing to have sex with, and were able to select as few (minimum 1) or as many as they wished.

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 a sexually transmitted disease/infection (STI) and least likely to have an STI. All participants picked at least 2 photographs; the same individuals 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, participants completed the various delay conditions, which were presented in random order within and between subjects.

For each SDT condition, participants were shown the photo of the specific individual they chose for each condition, and were instructed to keep in mind the person they chose for each condition (e.g., “Keeping in mind the person you most wanted to have sex with”). They were asked to imagine that they just met this person and they were both interested in having sex now. Participants were then presented with various delays related to this scenario. The 0-delay trial asked participants to rate on a 0-100 visual analogue scale how likely they are to use a condom assuming one is 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, participants were instructed to imagine that there was no condom available now. They were presented with
the choice of having sex now without a condom or waiting the specified delay (i.e., 1 hour, 3 hours, 6 hours, 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/non-monogamous 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, 2008) 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. 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 & Johnson (2015). If two or more points were
nonsystematic in a single condition, the participant’s data were excluded for that
condition only.

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 on
delay alone on sexual discounting, a standard value was computed by dividing delay
trials by the 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 (see
Hermann, Johnson & Johnson, 2015). 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.

Because a high proportion (53.8%) of individuals reported a 0% likelihood of
using a condom in the 0-delay trial of the relationship condition of the SDT, both a
standardized and non-standardized value were calculated in the analysis of the
Relationship condition of the SDT, as standardization would require removal of more than half of our sample. For between-groups comparisons, both the standardized and the non-standardized 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-participant 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. Where possible, Cohen’s $d$ was used as a measure of effect size (Cohen, 1988). Correction for dependence between means was made for effect size 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, no covariates were modeled.
Chapter 3: Results

Data Quality of the SDT

Sample-wide, 104 data points (7.82%) from 50 participants were flagged as nonsystematic, consistent with data quality from past studies using the SDT (e.g., Johnson & Bruner, 2012; Dariotis & Johnson, 2015). Of these participants, most (34 participants) had only a single nonsystematic data point. Data from one or more conditions were removed for 11 participants who had two or more nonsystematic points in a single condition.

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 ($M = 87.01$, $SD = 25.16$), $t(230) = 6.67$, $p < .001$, $d = 0.46$. 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 ($M = 91.92$, $SD = 19.0$), $t(233) = 8.21$, $p < .001$, $d = 0.60$. 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 ($M = 75.44, SD = 34.76$), $t(154) = 11.14, p < .001, d = 0.90$. This difference remained when examining only participants who reported any likelihood greater than 0 of using a condom with their main sex partner ($M = 72.34, SD = 36.45$) compared to the partner chosen as “most want to have sex with” ($M = 87.27, SD = 26.53$), $t(72) = 3.71, p < .001, d = 0.45$.

Comparisons Across SDT Partner Conditions

Figure 1 presents sexual discounting between groups and conditions. As a whole, participants showed significantly steeper discounting in the Most Sex partner condition ($M = .45, SD = .42$) compared to Least Sex ($M = .72, SD = .42$), $t(208) = 9.94, p < .001, d = 0.69$. Similarly, participants showed significantly steeper discounting in the Least STI partner condition compared to the Most STI partner condition, $t(215) = -8.95, p < 0.001, d = 0.63$. This finding demonstrates that individuals report being 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 condition, such that MSM and heterosexual men had comparable discounting rates for each of these four partner conditions.
Roughly two thirds of participants reported being in a current sexual relationship with a regular partner for at least the past 6 months, including 61 MSM (61.6%) and 97 heterosexual men (67.4%), $\chi(1) = .85, p = .36$. On average, participants were in these relationships for 74.61 months ($SD = 64.80$). 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, $\chi(1) = 1.88, p = .17$. In this condition, AUC values indicate that MSM ($M = .08, SD = .22$) discounted condom use at a steeper rate than heterosexual men ($M = .20, SD =$
This difference was also significant when examining standardized AUC values, which divide delay trials by 0-delay trial values and remove participants with likelihoods of 0 on the 0-delay trials (see above), $t(55) = -1.96$, $p = .05$. Thus, MSM were less likely to use condoms with main sexual partners compared to heterosexual men as a function of delay.

Paired sample $t$-tests were used to examine within-participant differences between the Relationship condition and both the Most Sex and Least STI conditions, which showed the steepest discounting rates among the original four SDT conditions. Participants showed steeper discounting rates in the Relationship condition ($M = .17, SD = .33$) compared to the Most Sex condition ($M = .47, SD = .42$), $t(136) = -8.10, p < .001, d = 1.29$. The same was true when comparing discounting rates in the Relationship condition to the Least STI condition ($M = .56, SD = .45$), $t(144) = -10.10, p < .001, d = 0.86$. When repeating these analyses using the standardized AUC values in the Relationship condition, these findings remained significant such that individuals in the Relationship condition still were found to discount at steeper rates, $t(67) = -3.13, p = .003, d = 0.38$ and $t(72) = -4.64, p < .001, d = 0.54$ for the Most Sex and Least STI conditions, respectively. This finding demonstrates that participants in a relationship show the steepest rates of discounting of protected sex with their main partner compared to all casual partner conditions.


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 \((n = 13, 9.0\%)\), \(\chi(1) = 9.24, p = 0.002\). All but 5 participants reported either being HIV-seronegative or unsure of their HIV status. 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. Both before and after removal of outliers (those who reported 30 or more lifetime sexual partners), MSM \((M = 8.05, SD = 8.58)\) reported more lifetime sexual partners than heterosexual men \((M = 5.65, SD = 6.42)\), \(t(224) = 2.39, p = .02\). In addition, MSM reported more sexual partners over the past year \((M = 2.06, SD = 3.93)\) than heterosexual men \((M = 1.09, SD = 0.88)\), \(t(238) = 2.85, p = .005\).

**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, and only 42.7% of heterosexual men reported doing do, \(\chi(1) = 2.89, p = .09\). Furthermore, 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 (17%) heterosexuals reported unprotected UAI in the past 6 months. These participants reported an average of 10.98 \((SD = 17.75)\) experiences of UAI, which did not differ by group, \(t(59) = 0.51, p = .61\).

**Associations between SDT Performance and Self-report Measures**

HIV risk behavior. Figure 2 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. 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, $r = -.17, p = .01$; the Most Sex condition, $r = -.15, p = .03$; the Most STI, $r = -.18, p = .01$; and the Relationship condition, $r = -.59, p < .001$. Only the Most Sex condition was associated with the number of past year sexual partners, $r = -.15, p = .03$.

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

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 ($M = 1.36, SD = 0.97$), $t(241) = 2.42, p = .02, d = 0.45$. Compared to heterosexual men, MSM were more likely to report ever using marijuana, $\chi(1) = 11.40, p = .001, OR = 1.56$; stimulants (crack, cocaine, methamphetamine), $\chi(1) = 8.32, p = .004, OR = 2.65$; and opioids, $\chi(1) = 9.53, p = .002, OR = 2.91$. The groups did not differ 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, $\chi^2(1) = 3.84$, $p = .05$, $OR = 1.50$; marijuana, $\chi^2(1) = 8.37$, $p = .004$, $OR = 1.78$; and opioids, $\chi^2(1) = 4.45$, $p = .03$, $OR = 2.91$.

**Impulsivity and Sensation Seeking**

Figure 2 provides overall patterns of correlations among variables. MSM and heterosexual men did not differ on overall impulsivity, as measured by the BIS, although the difference approached significance, $t(241) = 1.92$, $p = .056$, $d = 0.25$. However, MSM ($M = 24.89$, $SD = 6.87$) scored higher on sensation seeking than heterosexual men ($M = 22.57$, $SD = 6.90$), $t(241) = 2.58$, $p = .01$, $d = 0.48$. MSM ($M = 27.03$, $SD = 6.45$) also reported greater sexual sensation seeking than heterosexual men ($M = 23.93$, $SD = 6.53$), $t(241) = 3.65$, $p < .001$, $d = 0.34$. However, impulsivity and sensation seeking were associated with sexual discounting only on the Most STI condition, $r_s = -.13$, $p = .04$ and $-.17$, $p = 0.01$, for impulsivity and sensation seeking, respectively. In contrast, sexual sensation seeking was associated with all conditions of the SDT, including the Relationship condition, all $r_s \geq .xx$, all $ps \leq .yy$.

Impulsivity was not associated with condom use, $r_s \geq .035$, $ps \leq .57$. However, both sensation seeking and sexual sensation seeking were correlated with condom use on the last sexual experience, $r = .21$, $p = .001$ and $r = .33$, $p < .001$, respectively, such that higher sensation seeking and sexual sensation seeking indicated less likelihood of condom use. Similar associations were found between sensation seeking and sexual sensation seeking for past 3 month and past year condom use (see Figure 2). Finally, only sexual sensation seeking was associated with the number of lifetime and past year
partners, $r = .14, p = .03$ and $r = .19, p = .004$, respectively.

Figure 2. Correlations between measures. Correlations that are significant ($p \leq 0.05$) 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; DAST (Drug Abuse Screening Test); PSS (Perceived Stress Scale); AUDIT (Alcohol Use Disorder Identification Test); BSSS (Brief Sensation Seeking Scale); SSSS (Sexual Sensation Seeking Scale); Condom Use Last Sex refers to whether or not a condom was used during the last sexual intercourse; Condoms Past 3 Months and Condoms Past Year refer to the frequency of condom use over the past 3 months or year, respectively (1 = did not have sex in past 3 months/year to 6 = never used condoms in past 3 months/year).
Chapter 4: Discussion

This is the first study to compare sexual discounting rates between MSM and heterosexual men, and the first to examine sexual discounting with primary/committed sexual partners. Findings indicate that MSM and heterosexual men do not differ in discounting rates vis-à-vis casual sex partners. Rather, both groups decreased similarly in their likelihood of using a condom with a hypothetical casual sex partner as delay increased. Notably, 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; M. W. Johnson & Bruner, 2012). 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 validity of the SDT, which is sensitive to real-world experiences influencing risk perceptions. Notably, however, in considering potential implications of our findings, no participants reported current use of PrEP. Thus, all HIV-seronegative participants were at potential risk for HIV contraction.

Particularly for casual sex partners, individuals reported being likely to use a condom when readily available. However, in scenarios in which they had to wait before having
sex with a condom, participants hyperbolically decreased this likelihood as a function of delay. One advantage of a commodity-specific task such as the SDT is higher face validity than traditional monetary discounting tasks (Johnson & Bruner, 2012). It is conceivable that individuals could face experiences in their daily lives in which they have the option of having immediate, unprotected sex vs. waiting to have sex until they can buy a condom. However, having to wait to have sex with a condom may mean losing the opportunity for sex with this individual at this time. Our results demonstrate that when prospective sexual partners are perceived as low risk and/or highly attractive, the salience of immediate sexual reward outweighs that of protected but delayed sexual reward. In contrast, for prospective sexual partners who are deemed riskier and/or less attractive but nevertheless desirable, the delayed reward of protected sex is preferred over the immediate reward of unprotected sex.

The discounting rates we used were sensitive to partner conditions in the SDT, which is indicative of changes in condom use preferences depending on characteristics of sexual partners and delay. Although the likelihood of immediately available condom use was high for all partner conditions, this likelihood decreased differently for different partner conditions. Participants showed greater discounting of condom use for partners they most wanted to have sex with compared to least wanted to have sex with. Notably, participants reported also a high likelihood of using a condom with participants who were judged as most likely to have an STI or those they least wanted to have sex with, even with increasing delay. This finding highlights that, in general, people are more likely to endorse condom use when they judge a situation to be of higher. For example, MSM use
condoms more often with partners they meet online or through a geosocial networking dating app (e.g., Grindr) than with partners they meet offline (Rice, 2012). This suggests that individuals are likely to change their behavior to match perceived risk of STI/HIV contraction, consistent with numerous self-report and correlational findings (Gerrard, Gibbons, & Bushman, 1996; Mehrotra, Noar, Zimmerman, & Palmgreen, 2009; Misovich et al., 1997; Sheeran & Taylor, 1999).

Participants in a relationship with a primary/committed sexual partner demonstrated steeper discounting rates with this partner compared to all other hypothetical partner conditions, including the hypothetical partner considered the person they most wanted to have sex with. Critically, primary/committed partners are perceived as lower-risk than casual sex partners (Mehrotra et al., 2009). Studies show consistently that individuals are less likely to use condoms with primary/committed partners than casual partners (Lescano et al., 2006; Kapadia et al., 2007), and are more likely to engage in other HIV risk behaviors with primary/committed partners, such as substance use before sex (Lansky, Thomas, & Earp, 1998). To the best of our knowledge, our study is the first to demonstrate this relationship experimentally. Notably, this finding remained after removing half of the sample when standardizing AUC values, as described above.

Sample-wide, rates of consistent condom use were low, and over two thirds of MSM reported unprotected anal intercourse in the past 6 months. In addition, since 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, this demographic may be at high risk HIV and other STI contraction. Even individuals who would use a condom if it
were available with their primary/committed partner 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 one hour 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, among those who reported any likelihood of using a condom with their primary/committed sex partner, 75%, on average, were likely to use one. Thus, although most participants in a relationship with a primary/committed partner were unwilling to use a condom, those who were willing reported a high likelihood of use. Unfortunately, the limited sample size precluded further examination of condom use status by sexual orientation.

Findings may provide insight into intervention strategies. Although the likelihood of condom use on the 0-delay trial was lower in the Relationship condition than with any other partner condition, this likelihood was still quite high, especially compared to the 0% likelihood that most participants reported. Thus, it appears that once individuals are willing to use a condom with a primary/committed partner, they are quite likely to do so. Interventionists might therefore focus on individuals who would never be willing to use a condom with a primary/committed sexual partner.

Adding to prior studies linking decreased condom use between primary sex partners to a variety of factors including increased desire for intimacy, greater trust, and lack of worry about HIV contraction (see Mustanski et al., 2011, p. 228), our data demonstrate
that delay discounting plays an important role in the choice of whether to use condoms or not with primary/committed sex partners. Even those who were willing to use a readily available condom with their primary partner discounted this likelihood much more steeply for their main partner than hypothetical partners. Past studies show that individuals, including MSM, discount condom use more steeply with individuals perceived as more desirable and less risky compared to less desirable and more risky (Dariotis & Johnson, 2015; Herrmann et al., 2015; M. W. Johnson & Bruner, 2012; Thamotharan et al., 2017). It is therefore understandable that for a primary/committed partner who is perceived as both more desirable and less risky than casual partners, individuals would further discount condom use.

Despite within-group differences by SDT condition, no differences in discounting rates were found between MSM and heterosexual men on the original four SDT conditions. This suggests that both groups make similar decisions regarding condom use with casual sex partners, consistent with previous studies that show MSM and heterosexual men report similar rates of condom use (Glick et al., 2012; Kort et al., 2017). However, MSM demonstrated steeper discounting in the Relationship condition of the SDT compared to MSM. This finding further highlights the importance of understanding condom-use in the context of main partnerships/steady relationships compared to casual sex partners. 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.

MSM reported much higher rates of many substances, including stimulants, opioids,
and marijuana. MSM reported relatively high rates of ever using stimulants (methamphetamine, crack, or powder cocaine) and opioids (heroin, methadone, or prescription pain medication), 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, 2008; Hughes & Eliason, 2002; Marshal et al., 2008; Woody et al., 2001), findings that are often attributed to minority stress (Hatzenbuehler et al., 2008; 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, 2015; Patterson, 2005; Semple, Zians, Grant, & Patterson, 2006).

In addition, performance on the SDT was associated with self-reported impulsivity and sensation seeking, especially sexual sensation seeking. Impulsivity and sensation seeking are 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 impulsivity related to sexual rewards. In contrast, impulsivity as measured broadly by the BIS was generally unrelated to outcomes, whereas sexual sensation seeking demonstrated strong associations across measures. This provides
additional support for the use of commodity-specific delay discounting tasks for measuring outcomes such as sexual risk behavior.

There are 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, 2017d). 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 (e.g., Johnson & Bruner, 2012).

Despite these limitations, our findings clearly elucidate sexual discounting within the context of a primary relationship as a potential mechanism 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.
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