

**IMPULSIVITY AND GEOSOCIAL NETWORKING: ASSESSING HIV  
RISK BEHAVIOR IN YOUNG MEN WHO HAVE SEX WITH MEN**

An Undergraduate Research Scholars Thesis

by

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# TABLE OF CONTENTS

	Page
ABSTRACT.....	1
CHAPTER	
I INTRODUCTION .....	2
HIV risk behavior .....	3
Geosocial networking and HIV risk .....	8
Impulsivity .....	10
The present study .....	11
II METHODS .....	13
Participants .....	13
Measures .....	15
Procedure .....	18
Statistical Analysis.....	19
III RESULTS .....	22
HIV risk by time before meeting .....	22
GSN app use behavior by time before meeting .....	24
Impulsivity by time before meeting.....	26
Mediation Analysis .....	26
IV DISCUSSION.....	28
Conclusions .....	35
REFERENCES .....	37

## **ABSTRACT**

Impulsivity and Geosocial Networking: Assessing HIV Risk Behavior in Young Men Who Have Sex with Men. (May 2015)

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The use of geosocial networking (GSN) applications (apps) to meet individuals in close proximity for casual sex is on the rise, especially among young men who have sex with men (YMSM). Previous research has demonstrated an association between impulsivity and HIV risk behavior; however, little research has looked at GSN app use and impulsivity in YMSM or how these factors are related to subsequent engagement in HIV risk behavior. For the present study, YMSM ages 18-24 ( $n = 80$ ) were recruited through Amazon Mechanical Turk (MTurk) and social media. Participants were electronically administered measures assessing HIV risk behaviors, GSN app use and impulsivity. Significant differences by duration of time spent talking with an app partner before meeting them in person (Time Before Meeting) emerged for HIV risk behavior, how GSN apps were used and impulsivity, with less Time Before Meeting reflecting greater risk and impulsivity. Further, impulsivity was found to mediate the relationship between Time Before Meeting and HIV risk behaviors. These findings suggest that GSN app users, specifically those who have shorter Time before Meeting duration periods, may be at greater risk for HIV acquisition, and draw attention to the need to further examine use of GSN apps and impulsivity in YMSM.

# CHAPTER I

## INTRODUCTION

The incidence of YMSM who have been diagnosed with a sexually transmitted infection (STI), especially human immunodeficiency virus (HIV), has dramatically increased in recent years (Centers for Disease Control and Prevention [CDC], 2014a). Youth account for 26% of all new HIV infections (AIDS, 2014). Due to the long latency period between HIV acquisition and the development of Acquired Immunodeficiency Syndrome (AIDS), HIV/AIDS identified individuals in their late 20s and 30s was likely acquired during adolescence or emerging adulthood (Pandey, Dutt, Nair, Subramanyam, & Nagaraj, 2013). In 2010, young men who have sex with men (YMSM) were found to be disproportionately at risk for acquiring HIV, accounting for 72% of new HIV infections for individuals aged 13 to 24 (CDC, 2014a). This transmission often involves unprotected anal intercourse (UAI), which is the most common method of HIV transmission (CDC, 2014b). Unfortunately, many YMSM do not perceive themselves to be at risk for HIV acquisition (Landovitz et al., 2013). Sadly, around 18,000 individuals diagnosed with AIDS die each year (CDC, 2015). Although YMSM represent such a high-risk population for HIV acquisition and transmission, risk factors in this population remain under researched.

One risk factor that has only recently emerged is technology that allows for new means of communication and connection within the MSM population. Of important interest are geosocial networking (GSN) applications (apps), or smartphone apps that allow users to find other users of the app based on geographic location (Rice et al, 2012). Grindr, the most popular GSN app used by MSM, has gained over 5 million users worldwide since its introduction in 2009, with

thousands of new accounts created daily (Grindr, 2014). Grindr, which caters towards MSM, allows users to upload a profile picture, list demographic data including age, height and weight, gives space for users to describe their interests, and provides a platform for two users to chat with each other. It is through this chat platform that users can schedule to meet in person to engage in casual sex. Although some app users list reasons of use to be making new friends and having something to do while bored, the majority of users also report using GSN apps to find partners for casual sex (Beymer, Weiss, & Bolan, et al., 2014; Grosskopf, LeVasseur, & Glaser, 2014). Thus it is important to understand how GSN app use is contributing to the spread of HIV in YMSM.

### **HIV risk behavior**

HIV risk behavior is defined as behavior that increases exposure to HIV, which includes both sexual risk behavior and drug use. Although heterosexual and non-heterosexual men do not significantly differ in amount of sexual risk taking, MSM are at increased risk for contracting HIV (McCoul & Haslam, 2001). For the present study, HIV risk behavior included early age of sexual initiation, lack of or inconsistent condom use, increased number of lifetime sexual partners, casual sex, use of drugs before sex, previous diagnosis of HIV or another STI, and exchange sex (being paid money or goods, e.g., drugs for sex). Casual sex describes sexual behavior that results in a higher numbers of non-committed sexual partners, including short term sexual relationships (i.e., “one night stands”) and concurrent sexual partners.

Earlier age of sexual initiation is associated with HIV risk behavior. YMSM first engaging in sex before the age of 16 reporting higher levels of substance use, unprotected sex, and exchange sex

(sex for money or goods) than YMSM with later initiation of sexual contact (Outlaw et al, 2011). In MSM from outside of the US, earlier age of initiation for anal intercourse was related to diagnosis of HIV, increased number of sexual partners, inconsistent condom use and drug use before sex (Balthasar, Jeannin, & Dubois-Arber, 2008; Lyons et al., 2012). Research in heterosexual youth has demonstrated an association between early initiation of sexual intercourse with risk of STI infection (Kaestle, Halpern, Miller, & Ford, 2005; Coker et al., 1994). In addition, impulsivity and working memory were associated with early age of initiation for adolescent females (Khurana et al., 2012). Over all, earlier age of sexual initiation was also linked to a variety of HIV risk behaviors, including increased number of sexual partners, using drugs before sex, and inconsistent condom use (Patterson, Semple, Zians, & Strathdee, 2005; Sandfort, Orr, Hirsch & Santelli, 2008; Santelli, Robin, Brener, & Lowry, 2001). Finally, regardless of gender or age, youth who used condoms during initiation of sexual intercourse were more likely to report using a condom with their most recent partner than those who did not use a condom during their first sexual encounter (Shafii, Stovel & Holmes, 2007).

Another important HIV risk behavior is condom use, and rates of unprotected anal intercourse (UAI) are particularly high in YMSM (Grosskopf, LeVasseur, & Glaser, 2014; Rice et al., 2012). This behavior is especially risky for the receptive partner, as the thin lining of the rectum allows easier transmission of HIV and other STIs; however, risk of HIV transmission is also present for the insertive partner (CDC, 2014b). A meta-analysis sponsored by the CDC on UAI among HIV-seropositive MSM from 2000-2007 revealed that the general prevalence of UAI was 43%, with 30% of HIV-positive partners engaging in UAI (Crepaz et al., 2009). However, research on condom use has consistently shown that correct and consistent use of condoms during

intercourse can significantly reduce the transmission rate of HIV and many other STIs (Holmes, Levine & Weaver, 2004). When used correctly, condoms have been shown to be up to 95% effective at preventing STI transmission, and individuals who consistently use condoms are 10 to 20 times less likely to be infected with HIV compared to individuals who do not use condoms or use them inconsistently (Pinkerton & Abramson, 1997). Unfortunately, consistent condom use -- always using of a condom during intercourse -- is rare, but most research indicates that condoms are much more frequently used inconsistently rather than never (Grosskopf, LeVassuer & Glasser, 2014; Rice et al., 2012; Apostolopoulos, Sönmez, & Yu, 2002).

Multiple reasons for inconsistent condom use have been reported. Individuals who engage in UAI often believe they are unlikely to ever contract HIV, even if they are not aware of their partner's HIV status or history of STI diagnoses (Landovitz et al, 2013; Apostolopoulos et al, 2002). YMSM, ages 14-18, include embarrassment, confusion, and costliness of purchasing condoms as barriers to condom use, and are less likely to use a condom with a partner they trust (Mustanski, DuBois, Prescott, & Ybarra, 2014). Other reported reasons for inconsistent condom use include lack of access to condoms, distrust of condoms as effective means of preventing disease, and reduction of pleasure during sex (Harawa, Williams, Ramamurthim, & Bingham, 2006). In addition, adolescent males had less knowledge about AIDS and less positive views of condom use than females; however this study did not specifically query sexual orientation (Pack, Crosby and Lawrence, 2001).

Number of lifetime partners is also integral to understanding HIV risk. A greater number of sexual partners increases the opportunity to engage in sexual behavior with a partner who is

infected with and may transmit HIV (Finer, Darroch, & Singh, 1999). These partnerships may be monogamous but sequential or casual (e.g., one night stands, non-committed partners). Such encounters are associated with lower condom use, higher regret of having sex related to alcohol use, lower self-efficacy for using contraceptives and the likelihood of reporting having an STI (Kelley, Borawski, Flocke, & Keen, 2003). Many times, individuals are unaware that their partner has other sexual partners, and this is independently associated with risk of HIV transmission (Drumright, Gorbach, & Holmes, 2004). Moreover, research has consistently found that number of lifetime partners is positively correlated with rates of UAI in MSM, which in turn increases HIV acquisition and transmission (Dudley et al., 2004; Grosskopf et al, 2014; Pack et al., 2001; Rice et al., 2012). However, there is great variability in HIV risk behavior within individuals who have multiple lifetime partners, with some MSM with multiple partners endorsing increased precautions to reduce HIV risk, including frequent HIV testing (Rendina, Jimenez, Grov, Ventuneac, & Parsons, 2013).

Individuals who have a large number of partners are not the only individuals at high risk for the transition and acquisition of HIV. In fact, individuals who have a large number of sexual encounters with one or few different individuals are still at risk for HIV (Nordvik & Liljeros, 2006). This can be conceptualized with the idea of sexual networks, or individuals who are “linked by sequential or concurrent sexual partners” (Healthy People 2020, 2013). Therefore, although an individual may have had only one sexual partner, he will be at higher risk if his partner is part of a high risk sexual network (Healthy People 2020, 2013). This further suggests that sexual interactions, particularly involving high numbers of sexual encounters, with a casual partner increase the likelihood of infection when compared to an interaction with a non-casual



partner (Youm & Laumann, 2002). This is particularly salient in YMSM as a major contributor to the increasing incidence of HIV infection of YMSM is HIV-seropositive men who are unaware that they have HIV and continue to engage in unprotected, casual sex. These individuals are 3.5 times more likely to transmit HIV than individuals who are aware of their HIV-positive status (Marks, Crepaz, & Janssen, 2006).

MSM have been shown to use illicit drugs (with the exception of alcohol) at higher levels than their heterosexual counterparts (Woody et al., 2001; Stall & Wiley, 2008). A large body of research has shown that drug use before sex is associated with unprotected sex (Apostolopoulos et al., 2002; Hirshfield, Remien, Humberstone, Walavalkar, & Chaisson, 2004; Landovitz et al., 2013; Semple, Zians, Grant & Patterson, 2006). However, level of risk was dependent on the amount and type of substance used, with poppers, cocaine, and amphetamines being independently associated with increased rates of UAI (Colfax et al., 2004). As part of a longitudinal study of YMSM, it was revealed that the relationship between drug use and UAI decreased as the participants aged into adulthood, although there was still a significant effect of drug use on UAI independent of age (Newcomb & Mustanski, 2014). This suggests that YMSM compared to MSM are more vulnerable to HIV risk via use of drugs before engaging in sexual behavior. When examining GSN users, up to 50% of individuals reported engaging in drug use, especially alcohol and marijuana, before sex (Landovitz et al., 2013).

A small group of youth report engaging in exchange sex, or receiving money or goods for sex. However, a large majority of this group reports a previous diagnosis of HIV or another STI (Edwards, Iritani, & Hallfors, 2006). Other HIV risk behaviors associated with exchange sex include great numbers of lifetime partners, drug use, and unprotected sex (Jenness et al., 2011).

In addition, sexual minority youth engaging in exchange sex were significantly less likely to consistently use condoms with clients when compared to their heterosexual peers (Marshall, Shannon, Kerr, Zhang & Wood, 2010). One study found female injection drug users who also used exchange sex to support their drug use especially at risk, reporting very high number of past month sexual partners, unprotected intercourse, and sharing injection equipment (Benotsch et al., 2004).

### **Geosocial networking and HIV risk**

Due to the emergence of GSN apps within the last five years, little research has examined the role GSN app use plays in sexual risk taking. In addition, many studies have looked exclusively at Grindr, as it is the most popular GSN app used by MSM, and limited their samples to large metropolitan areas such as Los Angeles or New York. Although apps such as Grindr are not exclusively used for seeking casual sex partners, between 75% and 95% of men using these apps have had sex with a partner they met through the app (Grosskopf, LeVasseur & Glaser, 2014; Rice et al, 2012). Because of its extensive use for casual sex encounters, at present, GSN app use is considered an HIV risk behavior.

Several group differences have been found when comparing MSM who use GSN apps and those who do not. Those who use GSN apps have been found to be significantly younger, have more casual sex partners, as well as lifetime and recent sexual partners, been tested for HIV in the past 12 months, be more open about their sexual orientation, and report higher use of non-injection drugs when compared to non-GSN app users (Bien et al., 2015; Landovitz et al, 2013; Lehmillier

& Ioerger, 2014; Rice et al., 2012; Phillips et al., 2014). However, the effect this has on increased HIV risk remains mixed.

A study of nearly 7200 MSM in Los Angeles found that individuals who exclusively use GSN apps to meet sexual partners were no more likely to test positive for HIV, compared to individuals who meet sexual partners only in person, but those who used GSN apps had higher rates of gonorrhea and chlamydia (Beymer et al., 2014; Landovitz et al., 2013). MSM that meet a partner through Grindr are more likely to use a condom with that partner than with someone they met elsewhere (Rice et al, 2012). To add, MSM who use the Internet to find sex partners found that although individuals who used the Internet exclusively had higher number of partners, they endorsed lower rates of UAI than those who met partners both online and offline, though both rates were high at 29% and 43%, respectively (Horvath, Simon & Remafedi, 2008). It is important to note that individuals who use both apps or the Internet and in person as a means to meet partners appear to be a great risk and transmit this risk in both an online or in person medium. These findings were not supported in a study which found that MSM who used GSN were over twice as likely to report UAI with their last partner met through any medium, and four times as likely to report UAI with their last partner met through GSN applications (Holloway, Pulsipher, Gibbs, Barman-Adhikari, & Rice, 2015). However, this difference may be due to sample size, particularly examining exclusively GSN app using and Internet using MSM and those who use both social media platforms and in person to meet contact. Again, reinforcing that YMSM who use both may be at greater risk. Previous research on GSN use has been limited to looking only at use versus non-use, metropolitan areas and primarily Euro-American samples (Holloway, Dunlap, et al., 2014).

## **Impulsivity**

Impulsivity is described as a “behavior without adequate thought, the tendency to act with less forethought than do most individuals of equal ability and knowledge, or a predisposition toward rapid, unplanned reactions to internal or external stimuli without regard to the negative consequences of these reactions” (International Society for Research on Impulsivity, 2015). It is a multidimensional construct that can be thought of as a diminished ability to inhibit action, acting without concern for negative consequences, and a failure of attention (Logan, Schachar, & Tannock, 1997; Reynolds, Penfold, Patak, 2008; Semple et al., 2006;). Impulsivity has been linked to a broad range of risk behaviors, including smoking, gambling, obesity, and especially substance use (Fields, Collins, Leraas, & Reynolds, 2009; Dussault, Brendgen, Viatro, Wanner & Tremblay, 2011; Thamotharan, Lange, Zale, Huffhines & Fields, 2013; Semple et al, 2006; Kahn, Kaplowitz, Goldman & Emans, 2002). Heterosexual and homosexual males demonstrate no significant differences in impulsivity (McCoul & Haslam, 2001).

Within heterosexual youth, impulsivity has been consistently linked to sexual risk behavior (Cooper, Woods, Orcutt & Albino, 2003; Pack, Crosby, & St. Lawrence, 2001).

Among YMSM, associations have been found between impulsivity and UAI (Hays, Paul, Ekstrand, Kegeles, Stall & Coates, 1997; Dudley, Rostosky, Korfhage & Zimmerman, 2004; Pack, Crosby, & St. Lawrence, 2001). Similarly, HIV-seropositive individuals who scored high on impulsivity measures were more likely to abuse heavy drugs (e.g. methamphetamine and heroin as opposed to marijuana), have higher numbers of sexual partners, and higher rates of unprotected sex compared to HIV-seropositive individuals with low impulsivity scores

(Patterson, Semple, Zians & Strathdee, 2005; Semple et al, 2006). Only one study to date assessed similar psychological variables in users of GSN applications, which found no significant differences in sensation-seeking or self-control between users of GSN applications and non-users (Lehmiller & Ioeberger, 2014).

### **The present study**

Due to the recent development and increasing popularity of GSN apps in YMSM and high rates of HIV infection in this population, more research is needed to further understand HIV risk behaviors among YMSM GSN app users. Further, though GSN app users report frequent engagement of HIV risk behaviors, research has demonstrated that users are no more likely to be HIV positive than non-users (Beymer et al, 2014; Landovitz et al, 2013; Holloway, Dunalp et al, 2014). Therefore, understanding specific factors beyond GSN app use and why a subset of GSN users is engaging in HIV risk behaviors is critical. Thus the authors chose to examine the amount of time an individual talked to someone through a GSN app before meeting them (time before meeting) as a factor that could account for differences within GSN app users in HIV risk.

The present study had three main objectives. First, given the previous mixed results of HIV risk in GSN exclusive user and the limited demographics, the study aimed to move beyond comparisons of GSN app users and non-users by examining a specific GSN behavior, or duration of time talking to a partner before meeting them in person (time before meeting) in a diverse, geographically diffuse sample of YMSM who use both GSN app and other venues to meet partners. The second objective was to determine the influence of time before meeting on HIV risk, GSN app use behavior, and impulsivity. It is hypothesized that risk behaviors will differ

depending on time before meeting, with shorter durations associated with greater HIV and GSN app use risk behaviors and greater impulsivity. The third objective is to assess the relational dynamics of time before meeting, impulsivity, and HIV risk behavior. Research has examined impulsivity in relationship to some HIV risk behaviors in YMSM, but was not comprehensive and did not include GSN app use. In addition, no research to date has examined impulsivity as a mediator between GSN app use behavior and HIV risk behavior in YMSM. It is hypothesized that time before meeting will be associated with HIV risk behavior, and that impulsivity will account, at least partially, for this relationship. Understanding impulsivity and specific GSN app use behavior may identify new points of intervention that could lead to more effective strategies targeting the ability to restrain, disengage and resist HIV risk behaviors and could impact the HIV disparity among YMSM.

## CHAPTER II

### METHODS

#### Participants

For the present study, young men who have sex with men ( $n = 80$ ;  $M_{age} = 22.51$ ,  $SD = 1.48$ ) between the ages of 18 and 24 were recruited through Amazon Mechanical Turk (MTurk,  $n = 85$ ) and social media (i.e., Facebook and listservs of organizations serving the lesbian, gay, bisexual and transgender [LGBT] community,  $n = 22$ ). The majority of participants were Euro-American ( $n = 49$ , 61.3%), with other participants being African American ( $n = 15$ , 18.7%), Asian or Middle Eastern ( $n = 7$ , 8.8%), Hispanic ( $n = 5$ , 6.2%), or mixed race ( $n = 4$ , 5%). Most participants reported a homosexual orientation ( $n = 37$ , 58.8%), followed by bisexual ( $n = 31$ , 38.8%), heterosexual (and have sex with men;  $n = 10$ , 12.5%) and finally questioning ( $n = 2$ , 2.5%). In addition, the large majority of participants endorsed dating ( $n = 53$ , 66.3%) or being single ( $n = 16$ , 20.0%), while a minority of participants reported being in a monogamous relationship ( $n = 10$ , 12.5%) or being engaged ( $n = 1$ , 1.3%). The participants were geographically diverse, living in the South ( $n = 33$ , 33.8%), north ( $n = 21$ , 26.3%), West ( $n = 18$ , 22.5%), and Midwest ( $n = 14$ , 17.5%, see Table 1). Participants reported using online dating websites, smartphone apps, mutual friends, and approaching strangers as means to meet partners. Due to the nature of the present study, inclusion in the present study included the following criteria:

- (a) Male
- (b) Between the ages of 18 and 24
- (c) Engaged in sexual behavior with men
- (d) Not using GSN apps to meet partners

The present study sought to examine both a specific risk behavior, or GSN app use, and a specific health disparity or the growing burden of HIV on YMSM. Males who identified as heterosexual but engaged in sexual behavior with other males were included in the study.

Table 1

*Participant demographics*

	A few days or less		About a week		A few weeks to over a month		Total	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Sample size	31	38.75	21	26.25	28	35.0	80	
Ethnicity								
African American	3	9.7	4	19.0	8	28.6	15	18.7
Asian	5	16.1	1	4.8	1	3.6	7	8.8
Euro-American	18	58.1	14	66.7	17	60.7	49	61.3
Hispanic	3	9.7	2	9.5	---	---	5	6.2
Mixed race/other	2	6.5	---	---	2	7.1	4	5.0
Sexual Orientation								
Heterosexual (and have sex with men)	3	9.7	4	19.0	3	10.7	10	12.5
Homosexual	16	51.6	8	38.1	13	46.4	37	58.8
Bisexual	11	35.5	9	42.9	11	39.3	31	38.8
Questioning	1	3.2	---	---	1	3.6	2	2.5
Geographic region								
North	7	22.6	7	33.3	7	25	21	26.3
South	12	38.7	7	33.3	8	28.6	27	33.8
Midwest	6	19.4	2	9.5	6	21.4	14	17.5
West	6	19.4	5	23.8	7	25	18	22.5
Relationship status								
Single	11	35.5	1	4.8	4	14.3	16	20
Dating	16	51.6	18	85.7	19	67.9	53	66.3
Monogamous	3	9.7	2	9.5	5	17.9	10	12.5
Engaged	1	3.2	---	---	---	---	1	1.3
Age	<i>m</i>	<i>S.D.</i>	<i>m</i>	<i>S.D.</i>	<i>m</i>	<i>S.D.</i>	<i>m</i>	<i>S.D.</i>
	22.26	1.61	22.48	1.52	22.82	1.44	22.51	1.47



## **Measures**

### *Demographics*

The following demographics were gathered from those meeting inclusion criteria: age, sexual orientation, ethnicity, relationship status, and geographic region of residence. Sexual orientation included the response choices of (1) Heterosexual (and engage in sexual behavior exclusively with women), (2) Heterosexual (and engage in sexual behavior with men), (3) Homosexual (exclusively engage in sexual behavior with men), (4) Bisexual, (5) Queer, and (6) Questioning. A small number of individuals using GSN apps identify as heterosexual but also engage in sexual behavior with other men (Rice et al., 2012). Participants were also asked to self-identify their ethnic origin and included the following categories: African American/Black, Asian, Euro-American, Hispanic, and Mixed-race/other. Relationship status included single and not seeking a partner, casually dating, in a monogamous relationship, married, engaged, and divorced. Geographic region was reported as follows: (1) North, (2) South, (3) West, or (4) Midwest.

### *HIV risk behavior*

The author constructed HIV risk questionnaire included age of sexual initiation, number of lifetime partners, condom use frequency and ever having unprotected sex, attitudes towards casual sex, being tested for and/or diagnosed with an STI, being paid for sex, and use of drugs before sex. Response choices for *age of sexual initiation* and *lifetime partners* were queried using a free response format. *Condom use frequency* during anal sex was assessed using a 5 point scale including “never”, “rarely”, “sometimes”, “frequently”, to “always.” Attitudes towards casual sex were phrased with regard to willingness or past engagement in sexual behavior with a

recently-met partner and concurrently engaging in sexual behavior with multiple partners. Sexual behavior queried within casual sex questions referenced oral and anal sex. The *ever having unprotected sex, being tested for an STI, being paid for sex, and use of drugs before sex* was determined by “Yes” or “No” response choices.

A composite *HIV risk behavior score* was created by adding together the following items: age of initiation for kissing, touching underneath clothing, touching genitals, sexting, oral sex, and intercourse; number of lifetime oral sex and intercourse partners; frequency of past year condom use; engaging in unprotected sex outside of a committed relationship; willingness to have multiple oral sex or intercourse partners in the same week; having oral sex or intercourse with someone met recently for the first time; ever having an STI/HIV test; diagnosis of an STI/HIV; being paid for sex; and using substances before sex. *Age of initiation* was scored: 1--ages 21-24, 2-- ages 18-20, 3-- ages 16-19, 4-- ages 14-15, and 5-- age 13 or younger. Numbers of lifetime oral sex and sex partners were left as the number reported (e.g., if the individual reported 10 lifetime oral sex partners, 10 points were added to their composite score) to account for the increased risk associated with multiple partners. Higher scores indicated more engagement in HIV risk behaviors.

#### *Geosocial Networking App Use*

The present GSN app measure was modeled after the questions used in Rice et al (2012) and Landovitz et al. (2012). Questions were asked specifically about how the participant used GSN apps and app use behavior that contributed to HIV risk. These questions included asking the participants’ preferred method of meeting new people, with choices “online dating website,”

“smartphone application,” “through mutual friends,” “approaching a stranger in public,” or “other”; if they currently use a smartphone application to meet men in their area; how long they have been a user of the app, with choices ranging from less than one month to more than a year; how frequently the participant uses the app, ranging from more than once daily to less than once per week; the main reason for using the app -- making friends, sex, networking, dating, or other - -; how many of their friends use a GSN app -- all, most, many, few, or none --; how many people they talked to through the app in the past month, from 0 to 10 or more; how many people were met through the app were met in person, and how many sex partners were met through the app. The measure also asks how willing the participant is, on a scale from 0 to 100, to have oral sex or anal sex with a person met through the app. Similarly, it includes the question, “How likely are you to use a condom with someone you met through the app,” with answers choices: definitely, more likely, likely, somewhat likely, and not likely. GSN app use was examined within the context of the amount of time an individual talks to someone on a GSN app before meeting them in person, or “time before meeting.” Time before meeting was measured using a six point scale, ranging from “same day,” “a few days,” “about a week,” “a few weeks,” “a month or more,” to “N/A.” It was recoded into three groups 1) same day or a few days, (2) about a week and (3) a few weeks to a month or more.

### *Barratt Impulsiveness Scale (BIS-11)*

The Barratt Impulsiveness Scale (BIS-11, Patton, Stanford, & Barratt, 1995) is a 30-item questionnaire used to assess trait impulsivity. This questionnaire examines multiple dimensions of impulsivity categorized in three domains: attentional impulsiveness, motor impulsiveness, and nonplanning impulsiveness. Participants were instructed to answer quickly and honestly about

how they think and act in different situations. Responses were recorded on a Likert type scale, with choices “rarely/never,” “occasionally,” “often,” and “almost always/always.” Attentional impulsiveness involves how well an individual can focus on a task, e.g. “I concentrate easily.” Motor impulsiveness involves acting “on the spur of the moment,” e.g. “I buy things on impulse.” Finally, nonplanning impulsiveness involves making plans for the future, e.g. “I plan trips well ahead of time.” Higher scores reflect greater impulsive behavior.

### ***Procedure***

Waiver of consent, using documentation previously approved by the university’s Institutional Review Board, was obtained. Participants indicated their consent or non-consent by clicking “I do consent” or “I do not consent.” Those who did not consent were thanked for their time and exited out of the study.

Interested participants were instructed to follow a link hosted on Qualtrics, an online survey platform. Before being directed to the study, potential participants were given a screener to determine eligibility. These questions asked gender (male or female), age (17 or under, 18-24, 25 or older), sexual orientation (heterosexual, homosexual, or bisexual), and current use of a smartphone dating application (Yes or No). Those not meeting the above inclusion criteria were also thanked for their time and exited out of the study. Those meeting inclusion were then directed to the study and asked to provide their demographic information and complete measures assessing HIV risk, GSN app use and impulsivity. Instructions were provided for each measure. Completion time was approximately 15-30 minutes. Those participants completing the study on MTurk were compensated \$10 upon completion, while participants who took the study on a

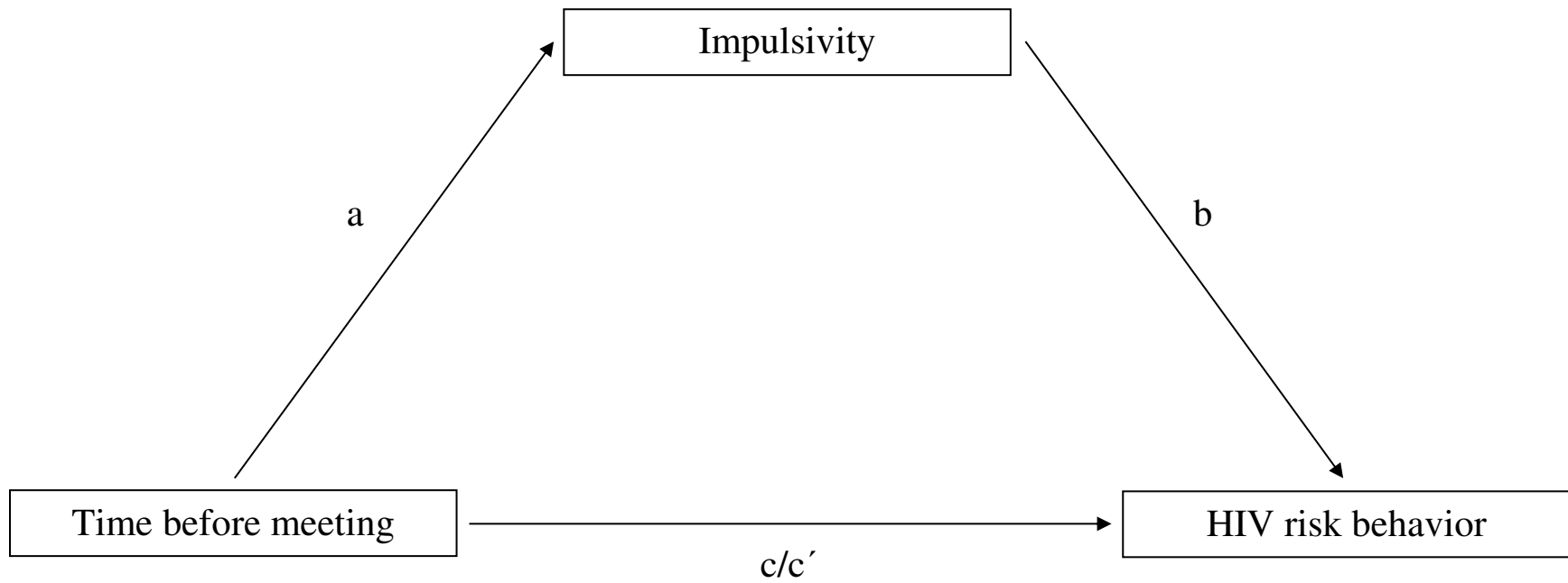
voluntary basis via posting on LGBT organizations' Facebook or through their listservs received no compensation.

### **Statistical Analysis**

Data analysis was conducted using SPSS 19.0. First, analysis of variance (ANOVA) was used to compare demographics by groups to determine any significant group differences that should be controlled for. However, groups were not significantly different on any demographic variables-- age, ethnicity, sexual orientation, relationship status and geographic region of residence. Next, bivariate associations between demographic variables and outcome variables -- HIV risk behavior, GSN app use and impulsivity -- were done by conducting a Pearson's product-moment *r*- test to determine which demographic variables should be included as covariates in each analysis

A 3 (time before meeting) x 19 (HIV risk behaviors) between subjects multivariate analysis of covariance (MANCOVA) to examine differences between groups based on time before meeting. Age, sexual orientation, geographic region, and relationship status were included as covariates. Likewise, a 3 (time before meeting) x 12 (GSN app use) MANCOVA was run to examine differences between groups with regard to GSN app use behavior. Age, ethnicity and relationship stats were included as covariates. Finally, a 3 (time before meeting) x 10 (impulsivity) MANCOVA was run. Geographic region was included as a covariate. A Tukey's post hoc analysis was conducted to determine which groups differed for HIV risk behaviors, GSN app use behaviors, and impulsivity measures, respectively.

A mediation analysis was conducted using the four step approach (Baron and Kenny, 1986) to understand the relational dynamics of time before meeting and impulsivity. Regressions conducted within the model include time before meeting, impulsivity, and HIV risk behavior. No covariates were included in the analyses. Assessing the model (Figure 1) required ordered regressions to test the a, b, ab, c, and c' pathways. The "a" pathway described the effects of time before meeting on HIV risk behavior. The "b" pathway described the effect of impulsivity, the mediator, on time before meeting, the dependent variable. The "ab" pathway shows the indirect effect of time before meeting on HIV risk behavior through the effects of impulsivity. The "c" pathway describes the effect of time before meeting on HIV risk behavior without the effect of impulsivity. Finally, the "c'" pathway describes the regression of time before meet on HIV risk behavior, controlling for the effect of impulsivity. If the "c" pathway was shown to decrease in the "c'" pathway, mediation occurred.



**Figure 1.** Mediation model of time before meeting, impulsivity, and HIV risk behavior

## CHAPTER III

### RESULTS

#### **HIV risk by time before meeting**

A main effect was found for time before meeting on the composite HIV risk ( $F_{(2,58)} = 12.84, p < 0.001$ ; see Table 2), for the initiation of touch underneath clothing ( $F_{(2,58)} = 4.58, p = 0.01$ ), sexting ( $F_{(2,58)} = 6.21, p = 0.004$ ), oral sex ( $F_{(2,58)} = 4.61, p = 0.01$ ), and anal sex ( $F_{(2,58)} = 3.94, p = 0.03$ ), but not for kissing or touch genitals. In addition a main effect was found for number of lifetime oral sex partners ( $F_{(2, 58)} = 13.78, p < 0.001$ ) and sex partners ( $F_{(2, 58)} = 7.45, p = 0.001$ ) as well as a willingness to have multiple oral sex partners ( $F_{(2, 58)} = 15.97, p < 0.001$ ) or sex partners in the same week ( $F_{(2, 58)} = 8.66, p = 0.001$ ); willingness to have oral sex ( $F_{(2, 58)} = 11.67, p < 0.001$ ) or sexual intercourse ( $F_{(2, 58)} = 5.91, p = 0.005$ ) with someone met recently for the first time; previous HIV/STI testing ( $F_{(2, 58)} = 3.53, p = 0.04$ ); and drug use before sex ( $F_{(2, 58)} = 7.14, p = 0.002$ ). No main effect was found for condom use frequency, ever engaging in unprotected sex, being diagnosed with an STI/HIV or being paid for sex.

Talking a few days or less before meeting was significantly different from both talking about a week and talking a few weeks to a month or more for total HIV risk, age of initiation of oral sex, lifetime oral sex partners, lifetime intercourse partners, and willingness to have oral sex with multiple partners in the same week. Talking a few days or less before meeting was significantly different from only talking for about a week for age of initiation of touching under clothing and intercourse. Talking a few days or less before meeting was significantly different from only



talking a few weeks to a month or more before meeting for age of initiation of sexting, willingness to have intercourse with multiple people in the same week, willingness to have sex with someone met recently and ever being tested for HIV or another STI. Finally, talking about a week was significantly different from talking a few weeks to a month or more for willingness to have or previously having multiple oral sex and intercourse partners in the same week. Those with a shorter duration of Time before meeting consistently endorsed greater risk behavior than their greater duration of Time before meeting counterparts.

Table 2

*HIV risk behaviors by time before meeting*

	A few days or less		About a week		A few weeks to a month or more		Time before meeting		Post hoc*
	<i>m</i>	<i>SD</i>	<i>m</i>	<i>SD</i>	<i>m</i>	<i>SD</i>	<i>F</i>	<i>p</i>	
HIV risk behaviors	56.77	20.12	34.43	12.24	34.25	14.59	12.84	<0.001	3 < 1; 2 < 1
Kiss <sup>a</sup>	3.77	1.28	3.10	1.21	3.75	1.13	1.63	0.21	---
Touch under clothing <sup>a</sup>	3.74	1.18	2.52	0.98	3.25	1.29	4.58	0.01	1 < 2
Touch genitals <sup>a</sup>	3.42	1.09	2.48	0.93	2.93	1.21	2.74	0.07	1 < 2
Sexting <sup>a</sup>	2.83	0.87	2.28	0.83	2.08	0.64	6.21	0.004	1 < 3
Oral sex <sup>a</sup>	3.23	1.02	2.32	0.67	2.56	1.16	4.61	0.01	1 < 2; 1 < 3
Sexual intercourse <sup>a</sup>	2.90	1.14	2.11	0.66	2.70	1.20	3.94	0.03	1 < 2
Lifetime oral sex partners	13.93	8.48	6.26	4.03	4.88	4.91	13.78	<0.001	3 < 1; 2 < 1
Lifetime intercourse partners	13.24	9.69	4.86	4.39	4.88	5.57	7.45	0.001	3 < 1; 2 < 1
Condom frequency	3.39	1.20	4.10	1.30	4.11	1.20	2.75	0.07	---
Unprotected sex	1.26	0.44	1.52	0.51	1.54	0.51	2.77	0.07	---
Multiple oral	1.10	0.30	1.48	0.51	1.82	0.40	15.97	<0.001	3 < 1; 2 < 1; 3 < 2
Multiple sex	1.16	0.37	1.38	0.50	1.79	0.42	8.66	0.001	3 < 1; 3 < 2

Recent oral	1.03	0.18	1.52	0.51	1.68	0.48	11.67	<0.001	3 < 1; 2 < 1
Recent sex	1.23	0.43	1.52	0.51	1.68	0.48	5.91	0.005	3 < 1
Tested	1.13	0.34	1.43	0.51	1.46	0.51	3.53	0.04	3 < 1
Diagnosed	1.84	0.37	1.95	0.22	2.00	0.00	0.96	0.39	3 < 1
Paid sex	1.90	0.30	1.90	0.30	1.89	0.31	0.08	0.92	---
Drugs before sex	2.55	0.99	2.33	1.15	1.86	1.01	7.14	0.002	3 < 1

Note: <sup>a</sup> denotes age of initiation, ages were recoded to the following: Age 13 or younger = 5, 14-15 = 4, 16-19 = 3, 18-20 = 2, 21-24 = 1; \* 1: talked a few days or less before meeting, 2: talked about a week before meeting, 3: talked a few weeks to a month or more before meeting

### **GSN app use behavior by time before meeting**

A main effect was found for time before meeting on GSN app use behavior (see Table 3).

Specifically a main effect was found for the number of people they have talked to through an app ( $F_{(2, 71)} = 4.29, p = 0.02$ ), number of individuals they have met in person ( $F_{(2, 71)} = 9.25, p < 0.001$ ), number of individuals they have sexually hooked up with, including just kissing or fondling ( $F_{(2, 71)} = 9.15, p < 0.001$ ), as well as the number of individuals they have kissed ( $F_{(2, 71)} = 4.09, p = 0.02$ ), had oral sex with ( $F_{(2, 71)} = 18.08, p < 0.001$ ), or had sexual intercourse with ( $F_{(2, 71)} = 6.37, p = 0.003$ ). In addition, groups differed significantly for the change in number of sexual partners since downloading an app ( $F_{(2, 71)} = 5.34, p = 0.007$ ), willingness to have oral sex with someone met through the app ( $F_{(2, 71)} = 8.66, p < 0.001$ ), and likelihood of using a condom with someone met through an app ( $F_{(2, 71)} = 4.64, p = 0.01$ ). However, no main effect was found for length of app use and willingness to have sexual intercourse with someone met through the app.

Talking a few days or less was significantly different from talking a few weeks to a month or more for number of people talked to through the app, number of people met through the app, number of people sexually hooked up with through the app, kissed, had intercourse with,

proportion of total sex partners met through the app, change in partners since downloading the app, likelihood of oral sex with someone met through the app, and likelihood of using a condom with someone met through the app. Talking a few days or less before meeting was significantly different from both talking about a week and talking a few weeks to a month or more for number of oral sex partners met through the app in the past month. Similar to HIV risk, those with shorter durations of time before meeting engaged in greater risk via GSN app use than those with longer duration periods.

Table 3

*GSN app use by time before meeting*

	A few days or less		About a week		A few weeks to a month or more		Time before meeting		Post hoc*
	<i>m</i>	<i>SD</i>	<i>m</i>	<i>SD</i>	<i>m</i>	<i>SD</i>	<i>F</i>	<i>p</i>	
GSN app use									
Length GSN	3.10	0.94	2.81	0.81	2.75	0.75	1.53	0.22	---
Talked GSN	3.94	0.93	3.38	1.02	3.21	1.17	4.29	0.02	3 < 1
Meet GSN	2.42	0.85	2.00	0.63	1.68	0.61	9.25	<0.001	3 < 1
Hookup App	4.65	1.31	5.24	1.00	5.90	1.17	9.15	<0.001	3 < 1
Kiss App	1.97	0.71	1.67	0.58	1.46	0.58	4.09	0.02	3 < 1
Oral App	2.10	0.47	1.57	0.60	1.32	0.48	18.08	<0.001	3 < 1; 2 < 1
Sex App	1.81	0.60	1.52	0.51	1.36	0.49	6.37	0.003	3 < 1
Proportion of partners	3.77	1.18	4.05	1.47	4.75	1.27	3.62	0.03	3 < 1
Change in partners	2.00	0.58	2.29	0.64	2.50	0.69	5.34	0.007	3 < 1
Likelihood oral app	72.58	24.63	55.24	33.86	40.00	28.80	8.66	<0.001	3 < 1
Likelihood sex app	62.16	28.05	54.52	32.47	45.43	25.72	2.58	0.08	---
Likelihood condom app	2.06	1.24	1.48	0.68	1.32	0.86	4.64	0.01	3 < 1

Note: \* 1: talked a few days or less before meeting, 2: talked about a week before meeting, 3: talked a few weeks to a month or more before meeting

### Impulsivity by time before meeting

No main effect was found for BIS total scores, attention, cognitive instability, perseverance, or cognitive complexity. However, a main effect was found for motor impulsivity ( $F_{(2, 76)} = 3.19, p = 0.05$ ). GSN apps with a time before meeting of a few days were significantly more motor impulsive than those with a time before meeting of a few weeks or more (Table 4).

Table 4

#### *Impulsivity by time before meeting*

	A few days or less		About a week		A few weeks to a month or more		Time before meeting		Post hoc*
	<i>m</i>	<i>SD</i>	<i>m</i>	<i>SD</i>	<i>m</i>	<i>SD</i>	<i>F</i>	<i>p</i>	
BIS total	64.03	12.59	62.62	12.42	55.68	18.49	2.62	0.08	---
Attention Total	16.81	4.24	16.86	4.53	14.46	6.32	2.01	0.14	---
Attention	10.39	3.05	10.19	2.91	9.00	4.11	1.40	0.25	---
Cognitive instability	6.42	1.95	6.67	1.80	5.46	2.43	2.48	0.09	---
Motor Total	23.39	4.57	22.10	4.78	20.21	6.40	2.61	0.08	---
Motor	16.00	3.63	14.24	3.74	13.43	4.53	3.19	0.05	3 < 1
Perseverance	7.39	1.80	7.86	1.93	6.79	2.20	1.74	0.18	---
Nonplanning Total	23.84	6.38	23.67	5.13	21.00	6.86	1.89	0.16	---
Self-control	12.61	3.62	12.90	3.88	10.68	4.39	2.40	0.10	---
Cognitive complexity	11.23	3.18	10.76	2.14	10.32	3.16	0.84	0.43	---

Note: \* 1: talked a few days or less before meeting, 2: talked about a week before meeting, 3: talked a few weeks to a month or more before meeting

### Mediation Analysis

Time before meeting was negatively associated with impulsivity (see Table 5), as measured by the BIS total score, and impulsivity was positively associated with HIV risk behavior [Model  $R^2 = 0.30, F_{(2, 77)} = 16.32, p < 0.01$ ]. The indirect effects of time before meeting on HIV risk behavior via impulsivity was also significant [ $a \times b = -1.18, CI = -3.27 - -0.19$ ], supporting a

statistical mediation effect so that less time spent talking through a GSN app before meeting in person was associated with more impulsivity, which was also associated to higher rates of HIV risk behavior. Both the total effect of time before meeting on HIV risk behavior [ $b = -11.41$ ,  $t(79) = -5.12$ ,  $p = .03$ ] and the direct effect that controls for impulsivity [ $b = -10.23$ ,  $t(79)$ ,  $p < .01$ ] were significant, suggesting that the effect of time talking before meeting on HIV risk behavior was partially mediated by impulsivity.

Table 5

*Hierarchical regression analysis of time before meeting and impulsivity in predicting HIV risk behavior*

	Effect of IV on M (a)	Effect of M on DV (b)	Total effect (c)	Direct effect (c')	Indirect effect (a X b)	95% CI
Time before meeting	1.93**	0.13*	2.23**	2.23**	-1.18*	-3.27- -0.19

*Note:* Denotes significance at \*  $p < 0.05$ ; \*\*  $p < 0.01$

## **CHAPTER IV**

### **DISCUSSION**

The primary goal of the present study was to investigate the role of a specific GSN app use behavior or the amount of time an app user talked to someone through a GSN app before meeting them in person with regard to HIV risk behavior, GSN app use and impulsivity. Most research involving GSN app use in MSM has examined differences between GSN app users and non-users, leaving within group differences for GSN app users understudied. In addition, past studies of GSN app users have been geographically limited to large urban centers like Los Angeles and New York. This study was not geographically limited, and included GSN app users from across the US. This is the first study to examine both an important within group variable for GSN app users, or time before meeting as a HIV risk factor and the role of impulsivity in GSN app use of YMSM. Consistent with our predictions, results reveal a significant main effect for time before meeting and HIV risk behavior, GSN app use and impulsivity. GSN app users with shorter time before meeting endorse greater HIV risk behaviors, more HIV risk via app engagement and greater impulsivity. Also consistent with our prediction was the partial mediation of impulsivity on the relationship between time before meeting and HIV risk behavior.

As initially hypothesized, GSN app users with shorter periods of time before meeting had engaged in HIV risk behavior more than GSN app users with longer time before meeting. This included earlier sexual initiation, greater number of lifetime partners, engagement or willingness to engage in casual sex, being tested for an STI, and using drugs before engaging in sexual behavior. Historically, public venues such as bathhouses or parks have been used by around 50%

of MSM to find casual, usually anonymous, sex partners, and individuals who use these venues are at increased risk of HIV infection (Binson et al., 2001). From the early 1990s to 2003, the percentage of MSM who met their first same-sex sexual partner through the Internet increased from 3% to 61% in 2002 and continuing to increase, while those who met their first partner through venues such as bars and clubs has steadily declined from 34% to 17% (Bolding, Davis, Hart, Sherr & Elford, 2007). This suggests that the preferred medium for meeting sex partners is shifting to online platforms, which now include GSN apps.

However, as previously noted, not all individuals use GSN apps to find casual sex partners (Landovitz et al, 2013). Therefore, it is likely that individuals with short times of talk before meeting use GSN apps to find accessible, casual sex partners, as opposed to other users with longer durations of time before meeting, who may use GSN apps to make invested relationships such as friends, dating partners or to find monogamous partners. Although GSN apps provide a venue for meeting partners anonymously and easily, engagement in casual sex is associated with STI/HIV risk behavior in MSM (Mazick et al., 2005). YMSM who are seeking a committed relationship report lower rates of UAI and lower numbers of lifetime partners than those mainly interested in casual sex (Bauermeister, 2012). Thus it is not surprising that GSN users with a shorter duration of time before meeting would endorse significantly greater HIV risk behavior than users with longer durations of time before meeting.

Differences in app use behavior were also found by time before meeting. As stated previously although not all GSN app users use these apps exclusively for casual sex, the majority of users do report using GSN apps to some degree to find partners for casual sex (Beymer, Weiss, &

Bolan, et al., 2014; Grosskopf, LeVasseur, & Glaser, 2014; Landovitz et al, 2013; Rice et al, 2012). GSN app users who talked for a few days or less before meeting in person were significantly more likely to engage in high-risk behaviors via the app, including having more oral sex, intercourse, and kissing partners met through the app. In addition, individuals who talk a few days or less before meeting had a higher proportion of total sex partners that were met through an app, reported increased numbers of sex partners since downloading a GSN app, and reported a higher likelihood of having oral sex or intercourse with an app met partner. This group was also less likely to use a condom with a partner met through an app than other groups.

These findings support the supposition that GSN app users who spend less time talking on the app before meeting in person are at greater HIV risk because they are likely using the app as a means to gain casual sexual partners and engage in casual sex. Therefore it is not surprising that GSN users only interested in procuring casual sex talk to, meet and hook up -- kissing, orally and sexually -- with more people via the app, thereby having a greater proportion of partners from the app and having an increase in their number of sexual partners. However, no difference in unprotected sex and condom frequency was found between groups. This is consistent with previous findings which found that MSM GSN app users were not more likely to test positive for HIV than non-app users and that MSM who use the Internet or other social media to find sexual partners endorsed lower rates of unprotected UAI (Beymer et al., 2014; Horvath, Simon & Remafedi, 2008; Landovitz et al., 2013). It may be that GSN app users who use the app to find sex partners, especially those with a shorter duration of Time before meeting, are aware of their other HIV risk behaviors (e.g., greater partners, casual sex) are aware of this risk and use condoms as a means to circumvent this risk. But, although not significant GSN app users with



shorter Time before meeting were more likely to endorse every having unprotected sex and lower condom use frequency. This may related to why previous research did find that although MSM GSN app users were no more likely to have HIV, they did have higher rates of gonorrhea and chlamydia it may (Beymer et al., 2014). It may be that overall GSN app users with shorter time before meeting have been fortunate in not contracting HIV during UAI but their decreased consistency of condom use has increased their risk for other STIs. Findings from the present study indicate they may be aware of this increased exposure to HIV and other STIs, as this group was more likely to get tested than GSN app users with longer time before meeting. This is troubling given that these users are likely to have a large number of sexual partners, thereby tapping into a multitude of sexual networks, and even one instance of not using a condom or using it incorrectly can result in the contraction of HIV, if not another STI, further spreading these diseases into different sexual networks.

Impulsivity differed among time before meeting groups, thereby being indirectly associated with HIV risk behaviors and HIV risk behaviors via GSN app use. This is consistent with previous research which has linked impulsivity with sexual risk behaviors (Hipwell et al., 2010; Semple et al., 2006). Individuals who talked to someone a few days or less before meeting them in person reported the highest level of motor impulsiveness, although no significant difference was found between this group and the group of individuals who waited about a week before meeting someone in person. This finding helps elucidate why GSN app users with shorter duration of time before meeting would be at greater risk for HIV both directly and via the app. Due to their motor impulsiveness, which is characterized by a tendency to act “on the spur of the moment”, GSN app users who talk a few days or less may be more likely to accept or propose invitations to

meet and for casual sex compared to GSN app users with longer durations of time before meeting because they act spontaneously rather than giving thought to their decisions. The findings that they act quickly may contribute to why they are meeting partners so quickly after this first point of contact. Logically, less planning of behavior potentially leads to more meetings, allowing for more chances to engage in HIV risk behaviors. As noted above, many GSN app users report boredom as a reason they use the app. Therefore, it is understandable that when using the app while bored, if an opportunity to meet someone is presented, those with higher motor impulsiveness are more likely to engage.

Surprisingly, no significant differences were found for other factors of impulsivity as measured by the BIS-11. This supports one study which found no differences in sensation seeking or self control between GSN app users and non-users (Lehmiller & Ioeberger, 2014). These findings suggest that individuals who wait a few days or less before meeting may do so not because they are unable to control sexual urges, but because they are more likely to act on sudden drives to engage in a particular behavior. However the lack of differences for other domains of impulsivity and overall impulsivity may be an artifact of looking at group differences versus the group as a whole, which was done for the mediation analyses discussed below. Findings from the mediation do support that overall impulsivity is important when looking at GSN app users as one group.

Taken together, one important finding consistent throughout group difference analyses is the similarity between GSN app users who meet after a week to those after a few weeks to a month or more. Although GSN app users who meet after a week are at intermediate risk between users meeting within a few days and those meeting after a few weeks to a month or more, they are

more similar to the latter group. This suggests that taking time before meeting a partner via the app can result in safer sex and that individuals who do so are likely to engage in safer sex outside of the app and are less impulsive -- which is likely to reason for their healthier behavioral practices.

The separate contributions of GSN app use on HIV risk behavior (Beymer et al, 2014; Grosskopf, LeVasseur & Glaser, 2014; Landovitz et al, 2013; Lehmilller & Ioerger, 2014) and the effect of impulsivity on HIV risk behavior (Hays, Paul, Ekstrand, Kegeles, Stall & Coates, 1997; Dudley, Rostosky, Korfhage & Zimmerman, 2004; Pack, Crosby, & St. Lawrence, 2001) have been previously established. However, impulsivity has not previously been examined as a mediator of the relationship of GSN app use and HIV risk behavior. In the present study, impulsivity, as measured by the BIS-11 total score, partially mediated the relationship between talk before meeting and the engagement in HIV risk behaviors. Because the path from the independent variable (time before meeting) to the dependent variable (HIV risk behavior) showed a reduction in absolute size while remaining different from zero after the mediator was introduced, it was determined that impulsivity acted as a partial mediator (Hamilton et al, 2013). Although the BIS-11 total score did not significantly differ by individual group by talk before meeting, it did mediate the relationship between talk before meeting and HIV risk behavior. Across the model shorter time before meeting was associated with greater impulsivity, and greater impulsivity was associated with greater engagement in HIV risk behaviors. This partial mediation by impulsivity of time before meeting on HIV risk behavior demonstrates the importance of impulsivity in understanding HIV risk behavior in YMSM. But, given a partial mediation, impulsivity is not the only factor responsible for the effect of time before meeting on

HIV risk behavior. The significant direct effect of time before meeting on the engagement of HIV risk behavior indicated the importance of GSN app use as a factor impacting HIV risk in YMSM, even without the influence of impulsivity.

The present study had several limitations. First, although participants were geographically diverse, the large majority of participants reported a Euro-American/white ethnicity. Ethnic minority MSM, especially African American MSM, are at additional risk of HIV infection compared to Euro-American MSM (CDC, 2014a). In addition, all responses were self-reported which may lead to under-reporting socially undesirable behaviors such as casual sex and in many cases retrospective (i.e., questions regarding the sexual timetable). All data was cross-sectional. This is typically not preferred for mediation analyses and does not allow the establishment of causal relationship. However, the mediation model of this study can be used to suggest a structural relationship, which supports the present hypothesis (Iacobucci, 2008). Furthermore, although the mediation model accounted for only 30% of the variance in HIV risk engagement, this also indicates that a more complex model of factors may be involved in YMSM HIV risk. Due to the nature of GSN apps, which require a smartphone to use, YMSM of lower socioeconomic backgrounds may have been underrepresented in this study. This is significant as individuals with lower socioeconomic status are shown receive fewer services for treatment of HIV and are at increased risk for death related to HIV infection compared to wealthy individuals (Cunningham et al., 2005). Finally, this study did not examine YMSM younger than 18, and these individuals are at significant risk for HIV infection (Mustanski, Newcomb, DuBois, Garcia, & Grov, 2011).

## **Conclusions**

Despite the limitations, several important findings are noted. Time before meeting has emerged as an important factor in HIV risk behavior of YMSM who use GSN apps, with those who talk a few days or less before meeting generally showing greatest risk. Importantly, due to the sexual networks developed by GSN app use, even individuals who do not fall into this high-risk category are potentially exposed to HIV infection if they engage in sexual behavior with high-risk individuals. Furthermore, impulsivity was established as a mediator between time before meeting and HIV risk behavior, adding further insight to psychosocial variables that put YMSM at increased risk for HIV infection. A better understanding difference in GSN app users and impulsivity is integral to the developing intervention strategies to reduce the spread of HIV in YMSM, and more research is necessary to elucidate factors contributing to the continued increase in HIV infection among YMSM.

Future research might further examine differences within individuals who use GSN apps to find other factors that may contribute to increased HIV risk. Specifically, future research should incorporate greater diversity, both socioeconomic and ethnic, when examining GSN app use by YMSM. More thorough assessment of frequency of sexual engagement with the same partner met through a GSN app, as well as understanding of sexual networks within the context of GSN app users, is needed. In addition, although most GSN apps specifically marketed as dating apps require users to be at least 18 years old, other smartphone apps may contribute to HIV risk behavior in YMSM under age 18, as nearly 75% of teenagers report accessing the Internet through mobile devices (Madden, Lenhart, Duggan, Cortesi & Glasser, 2013). Finally, the

present findings can be used to better inform HIV prevention strategies for GSN app users, especially those who score high on impulsivity measure

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