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## AN EVENT-LEVEL ANALYSIS OF THE INTERPERSONAL FACTORS ASSOCIATED WITH CONDOMLESS ANAL SEX AMONG GAY, BISEXUAL, AND OTHER MEN WHO HAVE SEX WITH MEN (MSM) WITH ONLINE-MET PARTNERS

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## Abstract

The interpersonal determinants of condomless anal sex (CAS) within online-initiated sexual relationships remain poorly understood. Therefore, respondent-driven sampling was used to recruit a prospective cohort of sexually active gay, bisexual, and other men who have sex with men (MSM), aged 16 years in Vancouver, Canada. Follow-up occurred every 6 months, up to seven visits; at each visit participants reported their last sexual encounter with their five most recent partners. Stratified by self-reported HIV status, individual-level, interpersonal, and situational covariates of event-level CAS with partners met online were modeled using generalized estimating equations (GEE). CAS was reported during 32.4% ( $n = 1,015/3,133$ ) of HIV-negative/unknown men's events, and 62.1% ( $n = 576/928$ ) of HIV-positive men's events. Social (i.e., collective identity, altruism, network size, social embeddedness) and situational (i.e., number of encounters, location, comparative age, seroconcordance, substance use) factors were identified as important correlates of CAS. Implications include the need for HIV prevention addressing social contexts associated with CAS.

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In Canada, gay, bisexual, and other men who have sex with men (MSM) are over 70 times more likely to be infected with HIV than other men (Public Health Agency of Canada [PHAC], 2014). Responding to this epidemic, public health leaders have relied heavily on community-based organizations to establish broad safe-sex norms within gay communities (Centers for Disease Control and Prevention [CDC], 2006). As a frequent endpoint of these efforts, condoms have become one of the most well-established prevention technologies for stopping the transmission of HIV. However, over the past two decades condom use among MSM has declined (Paz-Bailey et al., 2016) resulting in the resurgence of HIV and other sexually transmitted infections within key subgroups.

As the waning in gay men's use of condoms has been temporally correlated with the emergence of the internet, researchers have sought to determine what role online social venues might play in facilitating HIV risk (Groves, Breslow, Newcomb, Rosenberger, & Bauermeister, 2014). Meta analyses of these studies suggest that men who seek sex online are more likely to report engaging in condomless anal sex (CAS; Lewnard & Berrang-Ford, 2014; Liao, Millett, & Marks, 2006). However, the causal mechanisms underlying increased risk observed among these men remain unclear. Further, within-person studies have been inconsistent in reporting whether condom use is actually less likely during online-initiated sexual encounters compared with those initiated via other venues (Melendez-Torres, Nye, & Bonell, 2015). The lack of a consistent association between CAS and meeting partners online suggests that this relationship may be influenced by other important factors.

In examining which factors might underlie the association between CAS and online sex seeking, we have previously compared men who seek sex online with those who do not (Card et al., 2016). These earlier findings indicated that online sex seeking MSM tended to be younger, had more Facebook friends, spent more social time with other gay men, were more emotionally attached with the gay community, and had lower communal sexual altruism scores. Contrary to dated narratives regarding the social isolation of internet users, these findings support research which suggest that online sex seeking MSM exhibit a variety of social attachments (Shilo & Mor, 2015).

We hypothesize that these social attachments might also play an important role in shaping their sexual behavior. After all, the social construction of individual's attitudes, risk perceptions, and behavior is well documented, both within the context of HIV and more broadly in the study of human anthropology, epidemiology, psychology, and sociology (Amirkhanian, 2014; Choi, Ning, Gregorich, & Pan, 2007; Fishbein & Ajzen, 2011; Fisher, 1988). Applying social perspectives to the examination of sexual behavior between men who meet online may therefore help us to (1) identify the underlying causes of risky sexual behavior between men who meet online and (2) understand how social influence can be leveraged to promote sexual health in online environments.

## METHODS

### STUDY PROCEDURE

With the aim of identifying the social factors predicting event-level CAS between online-met partners, the present analysis used prospective cohort data collected between February 2012 and August 2015 as part of the Momentum Health Study. As described elsewhere (Lachowsky et al., 2016; Moore et al., 2016), this cohort used respondent-driven sampling (RDS) to recruit men from Vancouver's gay community. Eligibility criteria included gender self-identified men (including trans men), aged 16 years, who lived in Metro Vancouver, reported sex with a man in the past 6 months, and were able to complete a questionnaire written in English. Participants provided written informed consent prior to enrolling in the study. At baseline and 6-month follow-up visits participants completed a computer-administered questionnaire, reported event-level data regarding their most recent sexual encounter with up to five of their most recent male sexual partners in the past 6 months, received an HIV rapid-test or had HIV-relevant blood work, and were screened for hepatitis C and syphilis. Participation in the cohort was optional and some participants chose only to participate in the cross-sectional (baseline) visit. Participants were given an honorarium of \$50 CAD for each completed study visit and \$10 for each RDS participant they recruited. Ethics approval was obtained from the research ethics boards at Simon Fraser University, the University of British Columbia, and the University of Victoria.

### MEASURES

**Independent Variables**—The explanatory variables examined in the present study were selected as they were considered to approximate the social and interpersonal experiences of MSM. These variables included demographic factors (which approximate the socio-structural experience of individuals), factors approximating connectedness to or participation in the gay community, and scales assessing emotional attachment to the gay community. Specifically, we assessed: age (in years), sexual identity (gay, bisexual, other), education (completed at least high school versus not), annual income (< \$30,000, \$30,000–59,999, \$60,000 CAD), employment status (employed or unemployed), the number of MSM participants knew in the Vancouver area (continuous), the number of MSM whom they knew well (continuous), the number of reported male anal sex partners within the past 6 months (continuous), the amount of social time participants spent with other MSM (25%, 26–75%, 76%), the frequency with which they visited gay bars/clubs, read gay news media, used apps and websites to find sexual partners, and attended gay-led group meetings; and

their level of participation in the most recent annual pride parade (spectated, participated, did not attend). Frequency items assessing participation in the gay community were reported on an ordinal scale (not in the past 6 months, less than once per month, about once per month, more than once per month) that captured the period of time between each follow-up period (6 months). Scales measuring important dimensions of emotional connectedness included: collective identity (Luhtanen & Crocker, 1991), social support (Lubben et al., 2006), loneliness (Gierveld & Tilburg, 2006), and communal sexual altruism (O'Dell, Rosser, Miner, & Jacoby, 2008). Table 1 provides descriptions of the scales used in this analysis.

In addition to the primary explanatory variables of interest in this analysis, we also included scales accounting for the possible confounding effects of sexual sensation seeking (Kalichman & Rompa, 1995), cognitive escape (McKirnan, Venable, Ostrow, & Hope, 2001), treatment optimism (Van de Ven, Crawford, Kippax, Knox, & Prestage, 2000), self-esteem (Herek & Greene, 1995), and anxiety and depression (Snaith, 2003). These were included as they have previously been identified as important predictors of sexual behavior among MSM (Neville & Adams, 2009). Likewise, variables assessing substance use (i.e., use of alcohol, marijuana, poppers, erectile dysfunction drugs, crystal meth, GHB, or ecstasy/MDMA) during or within 2 hours prior to sex were included as these to have been identified as important predictors of event level condom use (Rendina, Moody, Ventuneac, Grov, & Parsons, 2015; Shilo & Mor, 2015). Finally, as the present analysis was conducted using event-level data, we also assessed event-level characteristics including the number of times the respondent had ever had sex with their partner, the number of months since they first met their partner, their certainty regarding their partner's serostatus (Did not know partner's HIV status; Knew he was HIV-negative; Thought he was HIV-negative, but not 100% sure; Knew he was HIV-positive; Thought he was HIV-positive, but not 100% sure), where they had sex with their partner (at home of either partner, other), and their comparative age to their partner (younger, same, older).

**Dependent Variable**—To assess the primary outcome of interest we used event-level data asking each participant: “What sexual activities did you do with the partner named above the most recent time you had sex?” Participants were then presented with a list of several sexual behaviors (i.e., He fucked me in the ass and he did not use a condom, I fucked him in the ass and I did not use a condom, He gave me a blow job, I gave him a blow job, Rimming, Masturbation, etc.). From the list of behaviors, participants were asked to check all that apply. Events in which participants indicated either penetrative or insertive CAS were classified as Events with CAS. Events in which neither check box was selected were classified as Events without CAS.

## STATISTICAL ANALYSIS

All statistical analyses were conducted in SAS v9.4. The present study restricted analyses to events in which sexual partners were first met online (see Table 2). As a first step to model building, we used principal component analysis (PCA; Jolliffe, 2002) to construct an appropriate measure for community and social involvement that captured patterns in gay community participation, rather than attendance at a single activity or event. PCA results

identified two principal components outlined in Table 3. Based on the resulting component structure, these two principal components were identified as relating to social embeddedness (PC 1) and community engagement (PC 2)—two important dimensions of attachment (Herek & Greene, 1995).

Recognizing that the rationale for condom use differs significantly according to HIV status, our data were stratified by HIV self-reported serostatus, and separate analyses were conducted for HIV-negative/unknown and HIV-positive men with online-met partners. General estimating equations were used to model the bivariable and multivariable associations of event-level CAS (versus no CAS) with an online-met partner. This allowed us to account for observations over the course of participants' 7 study visits and multiple observations within each study visit (Liang & Zeger, 1986). Final multivariable models were used to identify the most salient covariates of CAS. Backwards elimination was used to construct multivariable models by including all factors of interest with bivariable associations that were significant at  $p$  0.20 and then manually removing variables with the highest Type-III  $p$  values until the quasi-Akaike information criteria (QIC) were optimized (minimized).

## RESULTS

### DESCRIPTIVE RESULTS

At the time this analysis was conducted a total of 774 participants completed the baseline visit, 519 completed the second visit, 469 completed the third visit, 413 completed the fourth visit, 321 completed the fifth visit, 173 completed the sixth visit, and 56 completed the seventh visit. Of the 774 participants, 760 reported at least one sexual encounter across their 7 study visits (baseline and follow-up). Approximately 74% of men ( $n = 558/759$ , 1 missing) reported at least one sexual event with an online-met partner, and 39% ( $n = 219/558$ ) of those participants reported CAS with an online-met partner. In terms of study visits, our analysis considered data from a total of 2,725 visits (median = 4,  $Q_1$ – $Q_3 = 1$ –5); 2,488 of which included at least one reported sexual partner's event, 946 reported data for five sexual partners (the maximum allowed); though only a minority of these ( $n = 171/946$ ) were reported by individuals who had reported no more than five sexual partners in the past 6 months. As participants could report up to five sexual encounters at each visit (one for each of their five most recent partners), of the 2,488 study visits, a total of 8,137 events were reported—an average of 3.3 events per study visit. Stratified by HIV serostatus, 53% ( $n = 3133/5909$ ) of events reported by HIV-negative/unknown men and 42% ( $n = 928/2210$ ) of events reported by HIV-positive men were with an online-met partner. Of these, 32% ( $n = 1015/3133$ ) of events reported by HIV-negative/unknown men and 62% ( $n = 576/928$ ) of events reported by HIV-positive men included CAS.

### ANALYTIC RESULTS

**HIV-Negative/Unknown Men**—Descriptive statistics, univariable associations, and multivariable associations for condom use among HIV-negative/unknown men are provided in Table 4. In multivariable generalized estimating equations (GEE) modeling of events reported by HIV-negative/unknown men, CAS was more likely among men with incomes

between \$30,000 and \$59,999 (compared with those who made < \$30,000), and those who reported knowing more MSM well. On the other hand, CAS was negatively associated with collective identity, communal sexual altruism, and social embeddedness PCA scores. In addition to these primary factors of interest, CAS was negatively associated with the use of apps and websites to seek sex; and positively associated with higher self-esteem scores, treatment optimism, sexual sensation seeking, and having had more recent sexual partners. On the event level, CAS was associated with having had more sexual events with the partner in the past 6 months, having sex at home (compared to some other location), increasing certainty of a partner's HIV status and of a partner's HIV-positive serostatus, and use of alcohol, poppers, and crystal meth prior to or during sex.

**HIV-Positive Men**—Descriptive, bivariable, and multivariable results for HIV-positive men are provided in Table 5. In multivariable GEE modeling of events reported by HIV-positive men, CAS was negatively associated with age, having a nongay identity (vs. gay), communal sexual altruism, and use of ecstasy/MDMA prior to sex. CAS was positively associated with having a greater than high school education (vs. no greater than high school), higher sexual sensation seeking, having had more sexual events with the event-level partner, being more certain of their partner's status, knowing or believing their partner was HIV-positive, and use of poppers or erectile dysfunction drugs prior to or during sex.

## DISCUSSION

### PRIMARY FINDINGS

In the present study we analyzed 1,298 sexual events between MSM who first met online. Of these, 38% ( $n = 490/1298$ ) included condomless anal sex—with a significant proportion (60%,  $n = 292/490$ ) of CAS events among MSM who were 100% sure of their partner's HIV status. These findings support previous research that indicates that MSM have the potential to achieve high levels of risk reduction through serodisclosure and other risk management strategies (McFarland et al., 2011). As research efforts continue to explore the rationale for sexual risk occurring within these contexts, our findings support previous evidence suggesting that behavior during these encounters is explained by the confluence of individual-, social-, and encounter-level factors, requiring a multi-level approach to addressing the risks found in online environments (Neville & Adams, 2009).

Beginning with individual-level factors, we note that among HIV-negative/unknown men, event-level CAS was associated with higher sexual sensation seeking (which was also significant for HIV-positive men), increasing frequency of online sex seeking, and having more recent male anal sex partners. As greater sexual sensation seeking and partner frequency have been associated with online sex seeking (Card et al., 2016), these factors likely moderate the relationship between internet dating and CAS (Horvath, Beadnell, & Bowen, 2006; Matarelli, 2013). Likewise, higher treatment optimism and substance use have also been associated with both online sex seeking and risky sexual behavior (Grosskopf, Harris, Wallace, & Nanin, 2011; Rendina et al., 2015; Shilo & Mor, 2015). This evidence reconfirms these factors as salient predictors of CAS during online-initiated sexual encounters.



We also observed that higher annual income for HIV-negative/unknown men, and greater formal education and younger age among HIV-positive men, were associated with higher odds for event level CAS. The significance of these factors may suggest that the social stratifications of peer groups play an important role in shaping normative sexual behavior within these groups. Indeed, previous research has shown how sexual expectancies, norms, and behaviors vary between gay subcultures (Adam, Husbands, Murray, & Maxwell, 2008a). It would therefore be unsurprising that fundamental social stratifications such as age and social class (represented by educational attainment and annual income) likewise shape the sexual norms of individuals in these strata. In addition to these normative pressures, men with greater affluence also have greater access or exposure to health information and social opportunities (Canadian Institute for Health Information [CIHI], 2008)—providing them with the knowledge, skills, and resources needed to safely navigate condomless sex with their online-met partners. Indeed, research on the efficacy of treatment as prevention (Rodger et al., 2016), pre-exposure prophylaxis (Grant et al., 2010), and other seroadaptive strategies (Vallabhaneni et al., 2012) highlights that the risks of CAS can be successfully mediated given that individuals are able to employ these strategies appropriately.

The present analysis also highlights the degree to which social embeddedness in the gay community might also influence sexual behavior. In the present analysis we observed that for each one-point increase in social embeddedness there was a 13% reduction in the odds for CAS among HIV-negative/unknown MSM, suggesting that social attachments with other gay men may have a significant protective effect against CAS. Meanwhile, the effect of community involvement, though significant in univariable analyses, was not selected as an independent covariate for CAS suggesting collinearity between community involvement and other social attachments. With consideration to the existing literature on social and sexual behavior, we suggest that the protective effects observed in the present analysis are likely the product of greater exposure to prevention messaging (CIHI, 2008) and social norms which encourage risk management behavior (O'Dell et al., 2008). For instance, we observed that each one-point increase in communal sexual altruism and each one-point increase in collectivism were associated with a 38% and 7% reduction in the odds for CAS among HIV-negative/unknown men, respectively. Noting that altruistic and collectivist feelings themselves are fostered within communities and through social attachments (O'Dell et al., 2008), this finding highlights altruism and collectivism as potent mechanisms by which social attachments can be leveraged to promote risk management.

With these effects in mind, we also note that the impact of normative influence depends on whether or not peer norms are consistent with risk reduction (Fisher, 1988). For instance, we found that, among HIV-negative/unknown men, knowing more MSM well was associated with a 3% increase in odds for event-level CAS. Likewise, among HIV-positive men, identifying as gay (versus other) was associated with a 60% increase in the odds for CAS. While it is unclear why these associations contradict those with collectivism, communal altruism, and social embeddedness, it is important to note that the social norms underlying these measures may not operationalize or diffuse using the same social mechanisms or within the same social networks (Adam et al., 2008a; Amirkhanian, 2014; Choi et al., 2007). For instance, men who know many gay men, but do not often participate in gay events or with gay organizations, may experience distinct normative influence from those who are

participating in their community more regularly. These findings therefore reinforce the importance of broad community-based prevention, reaching subgroups of varying levels of community connectedness, to establish consistent norms throughout the gay community.

With that said, the influence of social factors was not universal. In particular, CAS among HIV-positive men was not predicted by the number of MSM they knew, their level of social embeddedness, or whether they were involved in the community. In fact, on both the univariable and multivariable levels, CAS was predicted by a smaller subset of factors for HIV-positive men. In considering why social influence seems to have less potent impact on the sexual behavior of HIV-positive men, we note that previous research has found that an HIV diagnosis is akin to a wake-up call—promoting deep introspection, heightened cognition, and greater sensitivity to the risks of transmitting HIV (Chown et al., 2015; Gorbach, Drumright, Daar, & Little, 2006; Lawson & Flocke, 2009; Prochaska, Redding, Harlow, Rossi, & Velicer, 1994). It is possible that this experience over-takes the influence that other social forces might otherwise have in shaping behavioral intentions. Alternatively, HIV-positive men's heightened awareness of treatment options, and the role these have in preventing the spread of HIV (Rodger et al., 2016), may also have a significant impact on how these men view the necessity or relative efficacy of condoms. If reflective of the disposition HIV-positive men have towards condoms, this may explain the relatively higher rates of CAS observed among HIV-positive men, as well as the apparent null-effect of social influence in shaping their sexual behavior. Another explanation for the dampened association between social factors and CAS among HIV-positive men is that these men are merely influenced by different social forces not measured in our analysis, such as internalized HIV stigma and HIV specific social support (Burnham et al., 2016).

In addition to the individual- and social-level factors associated with event-level CAS, encounter-level dynamics, such as substance use and partner serostatus, were also highlighted as important determinants of CAS. For example, both HIV-positive and HIV-negative/unknown men were more likely to engage in CAS with partners whose HIV status they knew and with whom they had more previous sexual encounters. This suggests that some of the risk for CAS with online-met partners can be attributed to the development of greater trust and intimacy between partners (Greene, Andrews, Kuper, & Mustanski, 2014). While condom abandonment may not be a public health concern within monogamous seroconcordant relationships, or within relationships where the sero-positive partner is virally suppressed, condom use in open relationships or among single men remains an important prevention message, especially in environments where biomedical interventions, such as pre-exposure prophylaxis (PreP), are unavailable or difficult to access.

We also note that for both HIV-positive and HIV-negative/unknown men, CAS was more likely with partners whom the respondents knew were HIV-positive. In context of previous research which shows that MSM, and especially high-risk MSM, are actively managing their risks (Card et al., 2017), this finding may highlight the use of seroadaptive risk management strategies, such as serosorting, strategic positioning, and viral load sorting, by those seeking to reduce the risks of HIV transmission while also engaging in CAS. Indeed, previous research has shown that online venues promote serodisclosure and seroadaptive behavior (Berry, Raymond, Kellogg, & McFarland, 2008), and may even ease the process of



disclosing one's undetectable viral-load (Newcomb, Mongrella, Weis, McMillen, & Mustanski, 2016). This may be especially true in Vancouver where the benefits of treatment as prevention are widely publicized (Carter et al., 2015). Alternatively, these finding may also be the result of small counts, as only 60 out of 995 baseline events among HIV-negative/unknown men were with partners whom the respondents knew or believed were HIV-positive. It is also possible that these relatively few instances of serodiscordant CAS may represent encounters between individuals who, for various reasons, are less concerned about the risks for HIV acquisition during CAS (Hallal et al., 2015; Stolte, Dukers, Geskus, Coutinho, & de Wit, 2004).

## IMPLICATIONS FOR HIV PREVENTION

As other researchers have noted that the internet may pose significant risk by bringing together individuals from subgroups with incompatible sexual norms (Adam et al., 2008a; Adam, Husbands, Murray, & Maxwell, 2008b), our analysis highlights the internet as a prime target for socially driven HIV prevention. The U.S. CDC has identified a number of high impact strategies that might potentially be adapted to online settings (CDC, 2015). As we observed that condom use among HIV-negative/unknown men with online-met partners seems to be influenced by social norms, we suggest that social network strategies, in particular, such as those endorsed by the CDC, should be used to strengthen and leverage social and sexual relationships in order to establish broad safe sex, testing, and treatment norms. Further, our data highlight the need for targeted and holistic interventions which can address multiple endpoints—including teaching participants how to navigate condom negotiation and serodisclosure, both when sober and when under the influence of alcohol and drugs. Such prevention campaigns should be crafted in such a way that they are attractive and acceptable to men with high sexual sensation seeking and a history of other risk behaviors (i.e., substance use). Such sex positive campaigns might include a focus on risk reduction strategies (e.g., seroadaptation, PrEP), rather than traditional prevention goals (e.g., condom use).

## IMPLICATIONS FOR FUTURE RESEARCH

Our results highlight the value in examining how social factors shape prevention related behaviors. However, additional qualitative studies are needed to explain why some social factors are associated with greater sexual risk while others appear to have a protective effect. Further, additional quantitative analyses should aim to better understand relevant psychosocial (e.g., sexual sensation seeking, treatment optimism, communal altruism) and behavioral constructs (e.g., partner number, seroadaptation), and how these constructs might arise from socially driven processes. These proposed analyses will provide evidence-based rationale to support, focus, and fine-tune HIV-prevention messaging for online-engaged MSM. Further, while the data presented here were collected over several years, longitudinal analysis of these and other data sources are still needed to provide further information on the changing patterns of sexual behavior among MSM. Future analyses are also needed to help us understand how the internet can be used to facilitate safer sex practices, establish safe sex norms, and promote a sense of community among MSM who engage in online-based interactions.

## STRENGTHS AND LIMITATIONS

The present study is strengthened by its use of event-level data, which allows us to better draw associations between key factors of interest, increase accuracy of reporting, and reduce recall bias. While studies comparing event-level data and period-prevalence data suggest there is substantial agreement in these data types (Glick, Winer, & Golden, 2012), Mustanski (2007) reported that retrospective and event-level diary reports of CAS between online-met partners can result in contradictory results. However, event-level results are generally shown to produce more precise estimates of sexual behavior (Glick et al., 2012). Our study is also benefited by collecting information regarding multiple events over time, which improves the robustness of our results by increasing the number of observations per individual.

The present study is not without limitations. The use of respondent-driven sampling and unweighted measures limits the generalizability of this study to urban MSM accessible through MSM social networks. This limitation is exacerbated by small counts in some categorical items and by unique contextual factors associated with HIV treatment and risks (Moore et al., 2016). Further, our analysis included events between partners who initially met online and may not necessarily represent typical online initiated events (i.e., casual partners). As the nature of the relationships between partners in our event level data is unclear, we cannot determine whether respondent condom use is consistent across partner type, or whether they engage in CAS selectively—perhaps with committed partners only. Indeed, previous research has shown that condom use is less frequent with committed partners than with casual partners (Lachowsky et al., 2015). Further, because participants only reported their most recent sexual event with each of their five most recent partners over the past 6 months, it is possible that the events sampled are not representative of their typical behavior. Our data structure is also limited by the fact that we are unable to determine whether events reported at different study visits are with the same partner or with different partners. Additionally, the exclusion of variables which might also predict condom use subject our study to omitted variable bias.

## CONCLUSION

Despite these limitations, our findings indicate that condomless anal sex among MSM with online-met partners is associated with many diverse and inter-related factors concerning sexual partners, social groups, and communities—broadening the scope of HIV prevention priorities. Future HIV prevention efforts should aim to strengthen and leverage these relationships in order to best respond to the social and situational predictors for context-dependent condom use. By using these relationships to empower individuals as they navigate the experience of meeting sexual partners online, prevention campaigns can respond to the root causes of sexual risk in online environments.

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TABLE 1

## Details of the Psychosocial Scales Used

Scale	Scale Scoring	Example Item	Example Responses <sup>a</sup>
<b>Communal altruism</b> O'Dell et al. (2008) No. items: 6 Study $\alpha$ : 0.90	0-Not altruistic to 30-Highly altruistic	"I have safer sex because I want the gay community to survive."	1-Disagree strongly 2-Disagree somewhat 3-Neither agree nor disagree 4-Agree somewhat 5-Agree strongly
<b>Sexual sensation seeking</b> Kalichman and Rompa (1995) No. items: 11 Study $\alpha$ : 0.71	11-Low to 44-High	"I like to have new and exciting sexual experiences and sensations."	1-Not at all like me 2-Not like me 3-Like me 4-Very much like me
<b>Treatment optimism</b> Van de Ven et al. (2000) No. items: 12 Study $\alpha$ : 0.84	0-Highly skeptical to 35-Highly optimistic	"New HIV treatments will take the worry out of sex."	1-Strongly agree 2-Disagree 3-Agree 4-Strongly agree
<b>Negative self-esteem</b> Herek and Greene (1995) No. items: 7 Study $\alpha$ : 0.90	0-High self-esteem to 21-Low self-esteem	"I sometimes feel useless."	0-Strongly disagree 1-Disagree 2-Agree 3-Strongly agree
<b>Collective identity</b> Luhtanen and Crocker (1991) No. items: 4 Study $\alpha$ : 0.82	0-Unimportant to 12-Very important	"Being part of the gay/bisexual/queer community has a lot to do with how I feel about myself."	0-Strongly disagree 1-Disagree 2-Agree 3-Strongly agree
<b>Lubben social support</b> Lubben et al. (2006) No. items: 3 Study $\alpha$ : 0.86	0-No support to 15-Very supported	"How many of your friends do you see or hear from at least once a month?"	0-None 1-One 2-Two 3-Three or four 4-Five to eight 5-Nine or more
<b>Loneliness</b> Gierveld and Tilburg (2006) No. items: 6 Study $\alpha$ : 0.78	0-Socially embedded to 6-Lonely	"There are plenty of people I can rely on when I have problems."	0-Definitely yes 0-Somewhat yes 1-More or yes 1-Somewhat no
<b>Hospital anxiety and depression</b> Snaith et al. (2003) No. items: 14 Study $\alpha$ s: Anxiety Subscale: 0.81 Depression Subscale: 0.86	0 to 7-Normal 8 to 10-Borderline 11 to 21-Abnormal	Anxiety: "I get sudden feelings of panic" Depression: "I feel as if I am slowed down."	3-Nearly all the time 2-Very often 1-Sometimes 0-Not at all
<b>Cognitive Escape Motive</b> McKirnan et al. (2001) No. items: 12 Study $\alpha$ : 0.90	4—Low escape motive to 48—High escape motive	Being drunk makes me more comfortable sexually.	0-Strongly disagree 1-Disagree 2-Agree 3-Strongly agree

<sup>a</sup>Response options may vary or be reverse scored for some scale items.



## Inclusion Restrictions for Data Analysis

	Participants									Events					
	Baseline			Any Visit <sup>a</sup>			All Visits			Baseline			All Visits <sup>a</sup>		
	HIV –	HIV +	Total	HIV –	HIV +	Total	HIV –	HIV +	Total	HIV –	HIV +	Total	HIV –	HIV +	Total
Data Collected	551	223	774	551	223	774	1926	799	2725	—	—	—	—	—	—
Reported > 1 Sexual Event	538	211	749	539	221	760	1797	691	2488	1962	754	2716	6048	2326	8137
Valid Answers Provided	537	211	748	538	221	759	1796	691	2487	1955	747	2702	5909	2210	8119
Online-Initiated <sup>a</sup>	358	118	476	414	144	558	1202	385	1587	995	303	1298	3133	928	4061
Online-Initiated CAS Event <sup>a</sup>	97	74	171	127	92	219	371	231	602	300	190	490	1015	576	1591

<sup>a</sup>Included in bivariable and multivariable analysis.

**TABLE 3**  
Descriptive Statistics and Principal Component Analysis of Community and Social Factors

	Online-initiated		CAS		PCA		
	N	%	N	%	PC 1	PC 2	5
<b>Social Time Spent With Gay Men</b>					<b>44</b>		
25% or less of my social time	121	21.7	48	21.9			
26–50% of my social time	139	24.9	58	26.5			
50–75% of my social time	190	34.1	75	34.2			
More than 75% of my social time	108	19.4	38	17.4			
<b>Attend Gay Bars/Clubs, P6M</b>					<b>60</b>		<b>–3</b>
Not in the past 6 months	117	21.0	54	24.7			
Less than once per month	157	28.1	62	28.3			
About once per month	95	17.0	37	16.9			
More than once per month	189	33.9	66	30.1			
<b>Play on Gay Sports Team, P6M</b>					<b>25</b>		<b>–3</b>
Not in the past 6 months	495	88.7	200	91.3			
Less than once per month	19	3.4	6	2.7			
About once per month	10	1.8	3	1.4			
More than once per month	34	6.1	10	4.6			
<b>Attend Gay-Specific Groups, P6M</b>					<b>–10</b>		<b>68</b>
Not in the past 6 months	350	62.7	134	61.2			
Less than once per month	81	14.5	36	16.4			
About once per month	46	8.2	20	9.1			
More than once per month	81	14.5	29	13.2			
<b>Read Gay Newspapers/Magazines, P6M</b>					<b>15</b>		<b>30</b>
Not in the past 6 months	110	19.7	43	19.6			
Less than once per month	184	33.0	62	28.3			
About once per month	113	20.3	53	24.2			
More than once per month	151	27.1	61	27.9			
<b>Pride Parade Participation, P12M</b>					<b>28</b>		<b>22</b>
No	202	36.2	89	40.6			

	<b>Online-initiated</b>		<b>CAS</b>		<b>PCA</b>	
	<i>N</i>	%	<i>N</i>	%	<b>PC 1</b>	<b>PC 2</b>
Yes, spectator	279	50.0	103	47.0		
Yes, in or volunteer	77	13.8	27	12.3		

*Note.* Bold value indicates selection into primary component. CAS = condomless anal sex; PCA = principal component analysis; PC = principal component; P6M = past 6 months; P12M = past 12 months.

**TABLE 4**  
Descriptive, Univariable, and Multivariable Statistics for Event-Level Condomless Anal Sex Among HIV-Negative/Unknown MSM

	Baseline				All Visits			
	Online-initiated		CAS		Univariable		Multivariable	
	(N = 414 MSM)		(N= 127 MSM)					
	N	%	N	%	OR	95% CI	aOR	95%CI
Individual-Level Factors								
Age (Median; Q1, Q3)	28.5	24, 36	31	25, 36	1.02	1.00, 1.03	Not selected	
Sexual Identity								
Gay	363	87.7	115	90.6	Ref			
Bisexual	23	5.6	8	6.3	0.92	0.57, 1.48		
Other	28	6.8	4	3.2	0.87	0.53, 1.43		
Race/Ethnicity								
Other	106	25.6	33	26	Ref		Not selected	
White	308	74.4	94	74	1.25	0.89, 1.74		
Highest Formal Education								
No greater than high school	62	15.2	23	18.3	Ref		Not selected	
Greater than high school	345	84.8	103	81.8	0.76	0.51, 1.14		
Annual Income								
< \$30,000	228	55.1	60	47.2	Ref		Ref	
\$30,000 to \$59,999	124	30	43	33.9	1.23	0.99, 1.54	1.31	1.01, 1.69
> 60,000	62	15	24	18.9	1.24	0.88, 1.76	1.13	0.79, 1.62
Currently Employed								
No	98	23.7	30	23.6	Ref			
Yes	316	76.3	97	76.4	1.09	0.82, 1.44		
Social Factors								
Number of MSM Known (Median; Q1, Q3)	40	20, 100	35	20, 100	1	1.00, 1.00		
Number of MSM Known Well (Median; Q1, Q3)	15	7, 30	20	8,30	1.03	1.00, 1.05	1.03	1.00, 1.05
Communal Sexual Altruism Scale (Median; Q1, Q3)	3.5	3.00, 4.00	3.17	2.83, 3.67	0.46	0.38, 0.56	0.62	0.51, 0.75
Collective Identity (Median; Q1, Q3)	8	6, 9	7	6, 9	0.90	0.86, 0.95	0.93	0.89, 0.98
PC 1: Social Embeddedness (Median; Q1, Q3)	3.08	1.91, 4.16	2.84	1.63, 4.03	0.86	0.79, 0.94	0.87	0.79, 0.96

	Baseline				All Visits			
	Online-initiated		CAS		Univariable		Multivariable	
	(N = 414 MSM)		(N = 127 MSM)					
	N	%	N	%	OR	95% CI	aOR	95% CI
PC 2: Behavioral Involvement (Median; Q1, Q3)	252	1.79, 3.43	232	1.68, 3.14	0.87	0.79, 0.96	Not selected	
Lubben Social Support Scale (Median; Q1, Q3)	11	9, 13	11	9, 13	0.99	0.95, 1.03		
Loneliness Scale (Median; Q1, Q3)	2	1, 4	2	0, 4	1	0.94, 1.06		
<b>Sexual Risk Factors</b>								
Use Apps or Websites to Seek Sex, P6M								
No	31	7.5	9	7.1	Ref		Ref	
Yes, less than monthly	78	18.8	17	13.4	0.41	0.28, 0.59	0.61	0.39, 0.94
Yes, about monthly	67	16.2	22	17.3	0.48	0.32, 0.71	0.74	0.46, 1.17
Yes, more than monthly	238	57.5	79	62.2	0.4	0.28, 0.58	0.59	0.39, 0.89
No. of Male Anal Sex Partners, P6M (Median; Q1, Q3)	4	2, 8	5	3, 15	1.01	1.01, 1.02	1.01	1.00, 1.02
HADS-Anxiety Scale (Median; Q1, Q3)	8	5, 10	7	5, 11	1	0.97, 1.03		
HADS-Depression Scale (Median; Q1, Q3)	3	1, 5	3	1, 5	1.01	0.97, 1.04		
Negative Self-Esteem Scale (Median; Q1, Q3)	7	4, 9	6	3, 8	0.99	0.97, 1.02	0.97	0.94, 1.00
Treatment Optimism Scale (Median; Q1, Q3)	24	20, 27	25	21, 28	1.08	1.05, 1.10	1.05	1.02, 1.08
Sensation Seeking Scale (Median; Q1, Q3)	31	28, 33.5	32	29, 35	1.11	1.08, 1.15	1.08	1.04, 1.12
Cognitive Escape Scale (Median; Q1, Q3)	28	24, 32	29	24, 33	1.02	1.00, 1.04	Not selected	
<b>Situational Factors</b>								
No. of Sexual Events With Partner, P6M (Median; Q1, Q3)	2	1, 4	3	1, 8	1.03	1.02, 1.04	1.03	1.02, 1.04
Months Since First Sexual Encounter With Partner (Median; Q1, Q3)	3	1, 8	4	1, 11	1.01	1.00, 1.01	Not selected	
Location of Recent Sex With Partner								
Other	127	12.8	42	14	Ref		Ref	
Home of either partner	868	87.2	258	86	1.44	1.15, 1.81	1.34	1.06, 1.71
Knew HIV Status of Partner								
Did not know partner's HIV status	271	27.2	47	15.7	Ref		Ref	
Knew he was HIV-negative	338	34	108	36	3.04	2.32, 3.97	2.43	1.80, 3.28
Thought he was HIV-negative, but not 100% sure	326	32.8	106	35.3	2.18	1.70, 2.81	2.15	1.63, 2.84
Knew he was HIV-positive	56	5.6	39	13	4.9	3.42, 7.03	3.77	2.54, 5.58
Thought he was HIV-positive, but not 100% sure	4	0.4	0	0	2.9	1.37, 6.15	2.44	1.14, 5.21

	Baseline				All Visits			
	Online-initiated (N = 414 MSM)		CAS (N = 127 MSM)		Univariable		Multivariable	
	N	%	N	%	OR	95% CI	aOR	95% CI
Comparative Age to Partner								
Younger	312	31.4	107	35.7	Ref			
Same	314	31.6	84	28	0.92	0.75, 1.12		
Older	369	37.1	109	36.3	0.98	0.78, 1.22		
Event Level Substance Use Prior to or During Sex								
Alcohol	337	33.9	95	31.7	<b>1.2</b>	<b>1.01, 1.42</b>	<b>1.35</b>	<b>1.11, 1.64</b>
Marijuana	186	18.7	66	22	<b>1.36</b>	<b>1.11, 1.66</b>		
Poppers	181	18.2	69	23	<b>1.6</b>	<b>1.29, 1.98</b>	<b>1.4</b>	<b>1.10, 1.80</b>
Erectile dysfunction drugs	61	6.1	30	10	<b>1.74</b>	<b>1.28, 2.37</b>		
Crystal meth	40	4	28	9.3	<b>3.36</b>	<b>2.15, 5.25</b>	<b>2.83</b>	<b>1.64, 4.90</b>
GHB	25	2.5	17	5.7	<b>2.55</b>	<b>1.65, 3.96</b>		
Ecstasy/MDMA	26	2.6	14	4.7	<b>1.71</b>	<b>1.11, 2.63</b>		

*Note.* Bold text indicates  $p > 0.05$ ; italic text indicates continuous variable statistics are used (median; Q1, Q3). CAS = condomless anal sex; MSM = men who have sex with men; OR = odds ratio; aOR = adjusted odds ratio; CI = confidence interval; Q1, Q3 = quartile 1, quartile 3; HADS = Hospital Anxiety and Depression Scale; PoM = past 6 months



**TABLE 5**  
Descriptive, Univariable, and Multivariable Statistics for Event-Level Condomless Anal Sex Among HIV-Positive MSM

	Baseline				All Visits			
	Online-initiated		CAS		Univariable		Multivariable	
	(N=144 MSM)		(N = 92 MSM)					
	N	%	N	%	OR	95% CI	aOR	95%CI
<b>Individual-Level Factors</b>								
Age (Median; Q1, Q3)	46	38.5, 51	44	37, 50	0.98	0.96, 1.00	0.96	0.94, 0.99
Sexual Identity								
Gay	131	91.0	83	90.2	Ref		Ref	
Bisexual	9	6.3	6	6.5	0.48	0.22, 1.02	0.49	0.20, 1.17
Other	4	2.8	3	3.3	0.67	0.33 1.38	0.40	0.18,0.89
Race/Ethnicity								
Other	29	20.1	18	19.6	Ref			
White	115	79.9	74	80.4	0.83	0.46, 1.51		
Highest Formal Education								
No greater than high school	28	19.7	13	14.4	Ref		Ref	
Greater than high school	114	80.3	77	85.6	2.13	1.14,3.96	2.02	1.12, 3.64
Annual Income								
< \$30,000	92	63.9	59	64.1	Ref		Not selected	
\$30,000 to \$59,999	38	26.4	23	25.0	1.03	0.68, 1.56		
60,000	14	9.7	10	10.9	1.67	0.90, 3.10		
Currently Employed								
No	72	50.0	43	46.7	Ref			
Yes	72	50.0	49	53.3	0.90	0.62, 1.31		
<b>Social Factors</b>								
Number of MSM Known (Median; Q1, Q3)	70	30, 200	80	30, 200	1.00	1.00, 1.00		
Number of MSM Known Well (Median; Q1, Q3)	20	8, 50	20	7.5, 50	1.01	0.98, 1.04		
Communal Sexual Altruism Scale (Median; Q1, Q3)	2, 83	2.17, 3.83	2, 67	2.00, 3.50	0.60	0.48, 0.76	0.60	0.47, 0.77
Collective Identity (Median; Q1, Q3)	8	6, 9	8	6, 10	0.97	0.91, 1.04		
PC 1: Social Embeddedness (Median; Q1, Q3)	2, 68	1.52, 3.63	2, 90	1.57, 3.78	1.01	0.87, 1.18		

	Baseline				All Visits			
	Online-initiated (N=144 MSM)		CAS (N = 92 MSM)		Univariable		Multivariable	
	N	%	N	%	OR	95% CI	aOR	95%CI
PC 2: Behavioral Involvement (Median; Q1, Q3)	2.97	2.03, 4.42	3.25	2.06, 4.44	1.04	0.92, 1.19		
Lubben Social Support Scale (Median; Q1, Q3)	10	8, 12	10	8.5, 12	1.01	0.95, 1.07		
Loneliness Scale (Median; Q1, Q3)	3	1, 5	3	1, 5	0.99	0.91, 1.09		
<b>Sexual Risk Factors</b>								
Use Apps or Websites to Seek Sex, PeM								
No	8	5.6	5	5.4	Ref			
Yes, less than monthly	20	13.9	13	14.1	1.26	0.57, 2.81		
Yes, about monthly	21	14.6	11	12.0	1.21	0.52, 2.81		
Yes, more than monthly	95	66.0	63	68.5	1.04	0.50, 2.18		
No. of Male Anal Sex Partners, PeM (Median; Q1, Q3)	6	2, 20	9	3.5, 25	1.00	1.00, 1.01		
HADS-Anxiety Scale (Median; Q1, Q3)	8	5, 11	8.5	5, 11	1.00	0.96, 1.04		
HADS-Depression Scale (Median; Q1, Q3)	5	2, 7	5	2, 8	1.02	0.97, 1.07		
Negative Self-Esteem Scale (Median; Q1, Q3)	7	3, 9	7	4, 9	1.03	0.99, 1.09	Not selected	
Treatment Optimism Scale (Median; Q1, Q3)	29	26, 33	30	27, 33	1.04	0.99, 1.08		
Sensation Seeking Scale (Median; Q1, Q3)	32	29, 35	33	30, 36	1.12	1.06, 1.18	1.11	1.04, 1.18
Cognitive Escape Scale (Median; Q1, Q3)	31	27, 36	33	29, 37	1.03	1.00, 1.05		
<b>Situational Factors</b>								
No. of Sexual Events With Partner, PeM (Median; Q1, Q3)	2	1, 5	2	1, 4	1.03	1.01, 1.05	1.03	1.01, 1.05
Months Since first Sexual Encounter With Partner (Median; Q1, Q3)	5	1, 25	4	1, 21	1.00	1.00, 1.01	Not selected	
Location of Recent Sex With Partner								
Other	19	10.0	35	11.6	Ref			
Home of either partner	171	90.0	268	88.5	1.12	0.71, 1.76		
Knew HIV Status of Partner								
Did not know partner's HIV status	60	19.8	22	11.6	Ref		Ref	
Knew he was HIV-negative	52	17.2	26	13.7	1.74	1.16, 2.63	2.07	1.25, 3.43
Thought he was HIV-negative, but not 100% sure	22	7.3	9	4.7	1.75	1.12, 2.73	1.68	0.98, 2.85
Knew he was HIV-positive	153	50.5	119	62.6	6.81	4.29, 10.80	8.50	5.08, 14.22
Thought he was HIV-positive, but not 100% sure	16	5.3	14	7.4	5.30	2.42, 11.58	6.45	2.60, 15.99

	Baseline				All Visits			
	Online-initiated (N=144 MSM)		CAS (N = 92 MSM)		Univariable		Multivariable	
	N	%	N	%	OR	95% CI	aOR	95% CI
Comparative Age to Partner								
Younger	64	33.7	105	34.7	Ref		Not selected	
Same	60	31.6	113	37.3	1.47	<b>1.02, 2.12</b>		
Older	66	34.7	85	28.1	1.77	<b>1.11, 2.83</b>		
Event Level Substance Use Prior to or During Sex								
Alcohol	76	25.1	51	26.8	1.25	0.84, 1.86		
Marijuana	112	37.0	68	35.8	1.25	0.89, 1.75		
Poppers	147	48.5	108	56.8	<b>1.67</b>	<b>1.21, 2.31</b>	<b>1.73</b>	<b>1.16, 2.57</b>
Erectile dysfunction drugs	87	28.7	62	32.6	<b>1.82</b>	<b>1.31, 2.52</b>	<b>2.06</b>	<b>1.33, 3.18</b>
Crystal meth	102	33.7	80	42.1	<b>2.21</b>	<b>1.50, 3.28</b>		
GHB	47	15.5	36	19.0	<b>1.97</b>	<b>1.21, 3.21</b>		
Ecstasy/MDMA	24	7.9	16	8.4	0.82	0.36, 1.91	<b>0.33</b>	<b>0.11, 0.96</b>

*Note.* Bold text indicates  $p > .05$ ; italic text indicates continuous variable statistics are used (median; Q1, Q3). CAS = condomless anal sex; MSM = men who have sex with men; OR = odds ratio; aOR = adjusted odds ratio; CI = confidence interval; Q1, Q3 = quartile 1, quartile 3; HADS = Hospital Anxiety and Depression Scale; P6M = past 6 months.