Examining the Social, Sexual, and Technological Behaviour of Gay, Bisexual, and Other Men Who Have Sex with Men

by

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Abstract

Online sex seeking (OSS) has previously been associated with condomless anal sex (CAS) among gay, bisexual, and other men who have sex with men (GBM). Previous studies suggest that this association may be due in part to the uptake of OSS among GBM who are more likely to engage in CAS. This thesis examines the interpersonal factors that might underlie this association. Data for this thesis was collected through the Momentum Health Study, a longitudinal cohort of GBM living in Metro Vancouver and recruited using Respondent-Driven Sampling. Latent class analysis, hierarchical regression, and structural equation models examined (i) patterns of online and offline community connectedness, (ii) covariates of event-level CAS within the context of online-initiated partnerships, and (iii) confounding effects of collectivism on the OSS-CAS relationship. Latent modeling of patterns of community connectedness identified three classes: Class 1, “Socialites,” (38.8%) were highly connected both online and offline. Class 2, “Traditionalists,” (25.7%) were moderately connected with little app/website-use. Class 3, “Techies,” (35.4%) had high online connectedness and relatively low in-person connectedness. In multivariable modelling, Socialites had higher collectivism than Traditionalists, who had higher collectivism than Techies. Patterns of community connectedness were also related to HIV-testing, perceptions of HIV stigma, serodisclosure, and condom use. Supporting these findings, hierarchical event-level logistic regression showed that collectivism, altruism, and social embeddedness were protective factors against CAS – particularly for HIV-negative men. Structural equation modelling revealed that collectivism, altruism, and sensation seeking accounted for approximately 40% of the association between OSS and CAS. In conclusion, these analyses suggest that collectivism, and related sociocultural constructs, promotes greater adherence to established HIV-prevention practices (such as condom use) while individualism may be more amenable to novel risk-reduction strategies which may or may not include condoms. While further research is needed to understand the plasticity of these interpersonal factors, these results suggest that programs facilitating collectivism might have the potential to establish broad sexual health norms. Furthermore, sex-positive risk reduction is likely an important component of HIV prevention for GBM who are less attuned to traditional social influences and may predominantly use the Internet to connect with other GBM.

Keywords: Internet; Gay and Bisexual Men; Condom Use; Biopsychosocial Theory

“Believing, with Max Weber,
that man is an animal suspended
in webs of significance he himself has spun.
I take culture to be those webs, and the analysis
of it to be therefore not an experimental science
in search of law but an interpretative one
in search of meaning.”

- Clifford Geertz, 1973 -

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List of Acronyms

ABIC	Adjusted Bayesian information criterion
AIC	Akaike information criterion
AIDS	Acquired immune deficiency syndrome
ART	Antiretroviral Therapy
AUDIT	Alcohol Use Disorder Identification Test
BC	British Columbia
BIC	Bayesian information criterion
CAIC	Consistent Akaike information criterion
CAS	Condomless anal sex
CBO	Community-based organization
CI	Confidence interval
EDD	Erectile dysfunction drugs
GBM	Gay, bisexual, and other men who have sex with men
GEE	Generalized estimating equations
GHB	Gamma-Hydroxybutyric acid
HAART	Highly active antiretroviral therapy
HADS	Hospital Anxiety and Depression Scale
HIV	Human immunodeficiency virus
LCA	Latent class analysis
MDMA	Methylenedioxymethamphetamine (Ecstasy)
OSS	Online sex seeking
PHAC	Public Health Agency of Canada
PLHIV	People living with HIV
RAA	Reasoned Action Approach
RDS	Respondent-Driven sampling
sdCAS	Condomless anal sex with a serodiscordant partner or whose HIV status was unknown
SFU	Simon Fraser University
STI	Sexually transmitted infection
TasP	Treatment as Prevention

Chapter 1.

Introduction

1.1. Synopsis

Online sex seeking (OSS) has previously been associated with increased condomless anal sex (CAS) among gay, bisexual, and other men who have sex with men (GBM). One theory for this association is that GBM who are more likely to engage in CAS are also more likely to seek sex online. Most empirical examinations of potential predisposing factors have examined the most proximal motivators for condomless anal sex (e.g., serosorting and strategic positioning). This chapter introduces the overall goal of this thesis which is to explore more distal socio-cultural and interpersonal factors that might explain the association between OSS and CAS by: (i) exploring the existing literature with the goal of better understanding the association between GBM's social behaviour and their use of apps and websites to find sexual partners, (ii) describing patterns of online and offline connectedness among GBM, (iii) examining factors associated with condomless anal sex within the context of sexual encounters between GBM who first met online, and (iv) characterizing the pathways by which various social factors and cognitive risk perceptions shape GBM's behaviour in online and offline environments. To accomplish these aims, this thesis used data from the Momentum Health Study, which is briefly introduced at the end of this chapter.

1.2. Background

1.2.1. HIV among gay and bisexual men

In the early 1980's, HIV spread rapidly among gay, bisexual, and other men who have sex with men (GBM; Landesman, Ginzburg, & Weiss, 1985). Among the many varied responses to which [unclear - missing words here?] community-based organizations began promoting condom use to prevent HIV transmission (Catania et al., 1991; Goldbaum, Yu, & Wood, 1996; Hunt et al., 1993; McKusick, Wiley, et al., 1985; McKusick, Horstman, & Coates, 1985; William, 1984; Winkelstein et al., 1988) – a response grounded in both neoliberal conceptions of risk and in desperation arising from

an absence of biomedical alternatives. Along with the emergence of antiretroviral therapies, public health campaigns promoting condom use contributed to dramatic decreases in the annual number of HIV infections (CDC, 2006; PHAC, 2014). However, with the availability of highly active anti-retroviral therapies and other seroadaptive strategies, prevalence of condomless anal sex (CAS) among GBM began increasing in the late 1990's (CDC, 1999; Khosropour et al., 2016; Lachowsky et al., 2016; Paz-Bailey et al., 2016). Consequently, HIV incidence among GBM remains elevated (CDC, 2012, 2015; PHAC, 2014) – and perhaps of greater relevance when it comes to condom use, the incidence of sexually transmitted infections (STIs) has reached record highs (CDC, 2017). This is despite (and in case of the latter – potentially due to) the efficacy of biomedical prevention strategies in reducing or preventing HIV transmission (i.e., Pre-exposure prophylaxis, antiretroviral therapy; Cohen et al., 2011, 2013; Grant et al., 2010; Montaner et al., 2014; Rodger et al., 2016). This has led some to wonder whether the benefits of "Treatment as Prevention" have been partially offset by increases in risky sexual behaviour (Brennan et al., 2010; Eaton & Kalichman, 2007; Jean et al., 2016).

1.2.2. The role of community, culture, and social norms in the HIV/AIDS epidemic

As I will attempt to show throughout this thesis, behaviour – and particularly risky sexual behaviour – is not a simple subject matter. Indeed, while I will focus on condom use as a key outcome, social and cultural influences continue to redefine concepts of "risk" and "safety" (Card et al., 2017). This is particularly true given the emergence of biomedical prevention strategies that have the potential to eliminate HIV transmission even in the absence of condoms (e.g., pre-exposure prophylaxis; Rodger et al., 2016). Underscoring the importance of recent changes in the context of the HIV epidemic, this thesis will discuss several salient constructs, such as "community," "social norms," and "culture" (as well as several other related terms and concepts). These concepts will allow us to articulate the various ways that broad social and structural forces impact behaviour (with exemplary mechanisms for these processes discussed in Chapter 6).

Regarding the first of these terms, this thesis defines community in the intellectual tradition of Weber, Tonnies, and Durkheim – contrasting it with the concept of society (or in Durkheim's case "organic solidarity"; Durkheim, 1893; Tönnies, 1887; Weber, 1922). Community, for my purposes here, will describe relationships built on cohesion, trust,

and solidarity. These “communities” tend to be close-knit, geographically defined, relatively homogenous, and collectivistic (Douglas & Calvez, 1990). Tangential to community, I will use the term “community connectedness” to describe various forms of engagement or attachment with these communities (e.g., seeking sex online, going to gay bars). In doing so, it is important to note that patterns of community connectedness are themselves instable – and indeed, previous authors have documented growing ambivalence towards the concept of community among GBM. These studies suggest that personal social networks are more relevant to GBM than institutional or traditional patterns of community attachment (Holt, 2011; Rowe & Dowsett, 2008; Wilkinson et al., 2012). While these shifts may reflect a transition in the ways GBM connect to communities, they may also reflect the growth of more individualistic forms of connectedness (i.e., those which maximize independence rather than interdependence and prioritize self-actualization over group cohesion). Indeed, some sociologists have come to describe this shift as one towards “networked individualism” (Wellman, 2001). For our purposes, we will not draw a specific distinction between “networked individualism” and “individualism” as only the former is conceptually feasible.

In addition to discussing community, this thesis will also consider the role of “social norms” and “culture” in shaping GBM’s behaviour. In doing so, I will rely on Schneider’s framework for comparing these related concepts. According to Schneider, “Culture contrasts with norms in that norms are oriented to patterns for action, whereas culture constitutes a body of definitions, premises, statements, postulates, presumptions, propositions, and perceptions about the nature of the universe and man’s place in it. Where norms tell the actor how to play the scene, culture tells the actor how the scene is set and what it all means. Where norms tell the actor how to behave in the presence of ghosts, gods, and human beings, culture tells the actor what ghosts gods, and human beings are and what they’re all about” (Quoted in Shweder, 1984, p. 93).

Applying this framework to the present subject matter, one must acknowledge the clear distinction between what is “actually dangerous” and what is “perceived” as “dangerous.” Doing so requires a constructivist approach, such as those advanced by Derrida, Foucault, and Butler – all of whom questioned the structural inherency of social norms and culture, arguing instead for the continual social fabrication of these factors (Butler, 1990; Derrida, 1978; Foucault, 2012). For example, one might argue that while HIV transmission is rooted in the biological interactions of viral and cellular membranes —

the way in which GBM relate to risk is entirely distinct from the true nature of transmission. In fact, it is the perceptions of risk, and not the particular risks (or dangers) themselves, that give rise to key patterns of risk management and sexual practice (Boholm, 2012).

1.2.3. The role of the Internet in the HIV/AIDS epidemic

Germaine to the concepts of community and culture, the emergence of the Internet in 1992 and its resultant impact on contemporary communities, has been regularly identified as a potential factor contributing to increased CAS among GBM (Grov, Breslow, Newcomb, Rosenberger, & Bauermeister, 2014; Lewnard & Berrang-Ford, 2014; Liau, Millett, & Marks, 2006; Yang, Zhang, Dong, Jin, & Han, 2014a; Zou & Fan, 2016). Literature reviews and meta-analyses of studies investigating the association between online sex seeking (OSS) and CAS have found that CAS is more likely among GBM recruited online (versus offline, Odds Ratio [OR] = 1.4, 95% Confidence Interval [CI]: 1.1 – 1.6; Yang, Zhang, Dong, Jin & Han, 2014), among GBM who seek sex online (versus no online sex seeking, OR = 1.7, 95% CI: 1.2 – 1.4; Liau, Millett, & Marks, 2006), and during online-initiated events (versus offline-initiated events, OR = 1.2, 95% CI: 1.0 – 1.5; Lewnard & Berrang-Ford, 2014). Likewise, a review and meta-analysis of 14 studies examining app-users (Zou & Fan, 2016) found that they were more likely to have ever been diagnosed with gonorrhoea (OR = 1.4, 95% CI: 1.2 – 1.6) and chlamydia (OR = 1.3, 95% CI: 1.1 – 1.5). Further, a recently published 6-year serial cross-sectional survey conducted in China also found that the total share of HIV cases among online sex seekers has increased, and that HIV prevalence is now significantly higher among these men (OR = 1.4, 1.0 – 1.9). Finally, at least one within-person analysis has suggested that GBM engage in greater CAS when meeting partners online compared to when they meet partners offline (Melendez-Torres, Nye, & Bonell, 2015).

While a number of high-quality studies have contradicted the association between Internet use and CAS (Grov, Hirshfield, Remien, Humberstone, & Chiasson, 2011; Mustanski, 2007), no reviews or meta-analyses have yet contradicted the general finding that CAS is more likely during online-initiated events. Further, as we are unable to randomly assign individuals to online and offline methods of sex seeking, it is unlikely that scientific scholarship will ever fully settle the debate regarding whether online venues contribute to greater sexual risk — especially in the face of industry pressures to

disregard positive findings (Rocha, 2015). Therefore, the more pressing need is to understand the association between OSS and CAS — answering the question: 'What factors contribute to greater risk-taking among gay and bisexual men in online sex-seeking environments?'

1.2.4. Rationale for the association between OSS and Sexual Risk

Two primary, potentially non-exclusive theories have been advanced to answer this question (Liau et al., 2006). The first theory, sometimes referred to as the "self-selection" hypothesis, suggests that risk-taking GBM are more attracted to and thus more likely to use the Internet to find sexual partners (Liau et al., 2006). Supporting this hypothesis, a number of studies have found associations between OSS and other risk factors for CAS, including: younger age, gay identification, higher socioeconomic status, greater sexual sensation seeking, substance use behaviour, and greater treatment optimism (Card, Lachowsky, Cui, Shurgold, et al., 2016a; Ogilvie et al., 2008; Zou & Fan, 2016). Further, a number of studies have found that many GBM who seek sex online also seek sex offline and that these GBM are at greater risk than those seeking sex using only online or offline means (Hirshfield, Remien, Humberstone, Walavalkar, & Chiasson, 2004; Horvath, Rosser, & Remafedi, 2008; Hull et al., 2016; Kerr, Pollack, Woods, Blair, & Binson, 2015; S. W. B. Noor, Rampalli, & Rosser, 2014a; Wei, Lim, Guadamuz, & Koe, 2014; D Zhang et al., 2007; Dapeng Zhang, Bi, Lv, Zhang, & Hiller, 2008).

The second theory, sometimes referred to as 'accentuation,' suggests that features of online-initiated events promote greater risk-taking (Liau et al., 2006). For example, GBM interacting online may become 'disinhibited' and perhaps engage in behaviour that they would not engage in with offline-met partners (Lapidot-Lefler & Barak, 2012; Suler, 2004a). Indeed, a growing body of literature suggests that sexual expectancies, arousal, and even behaviour can be primed by visual stimuli (P. C. G. Adam, Murphy, & de Wit, 2011; Roberts, Gibbons, Kingsbury, & Gerrard, 2014; Skakoon-Sparling, Cramer, & Shuper, 2016)—such as the grid of shirtless torsos characteristic of OSS venues (Roth, 2016). Another possibility is that incompatible sexual norms and scripts from diverse sexual networks are brought together via the Internet, leading to "failures" in sexual negotiation (Adam, Husbands, Murray, & Maxwell, 2008b). Such failures rely on the unspoken or taken-for-granted rules of conduct inherent in sexual scripts – such as those which unfold throughout a sexual encounter and facilitate strategic serosorting and

positioning behaviours. Of course, inherent characteristics of online venues may also contribute differentially to patterns of risk management (e.g., sero-disclosure, serosorting, strategic positioning, etc.; Grov, Agyemang, Ventuneac, & Breslow, 2013; Noor et al., 2014a)—perhaps by making these easier. While these hypotheses have generated an ever-expanding trove of research studies, most have not empirically demonstrated that the factors associated with OSS, are in fact the same factors predicting sexual risk between online-met partners.

While there is an ongoing debate regarding whether there is in fact greater risk with online-met partners (Lewnard & Berrang-Ford, 2014; Liau et al., 2006; Melendez-Torres et al., 2015), it is worth exploring what evidence might explain this association, if indeed it does exist. Unfortunately, most studies have used explanatory models, which do not directly test hypothesized factors as mediators. To my knowledge, only a few published papers (n = 12) have directly assessed and reported potential mediating factors that might drive the association between OSS and CAS.

The following paragraphs summarize the evidence with respect to Fishbein and Ajzen's Reasoned Action Approach (RAA) which is outlined in **Figure 1**. This framework has been widely used to study human behaviour, including condom use – with respect to which it is one of the most widely validated frameworks in the field of behavioural science (Albarracín, Johnson, Fishbein, & Muellerleile, 2001; W. A. Fisher, Fisher, & Rye, 1995; Martín, Martínez, & Rojas, 2011; Steinmetz, Knappstein, Ajzen, Schmidt, & Kabst, 2016). Attempting to isolate only the most salient factors shaping behaviour, this framework describes how behavioural, normative, and control beliefs – arising from background factors – contribute to intentions and ultimately to one's behaviour (Fishbein & Ajzen, 2009). While there is undoubtedly a "behaviour-intention gap," the model has nevertheless been useful in understanding and describing complex behaviour (Paschal Sheeran, 2002).

Background Factors. A variety of potential background factors shape the relationship between OSS and CAS. Of these, HIV status is the most commonly considered factor—suggesting that behavioural, normative, and control beliefs in online-settings are significantly influenced by social and cultural factors relating to HIV risk and risk management. While some studies have found that OSS is not associated with CAS among HIV-positive men (Benotsch, Kalichman, & Cage, 2002; Grov, Parsons, & Bimbi,

2007), others have found that HIV-positive men are more likely to engage in CAS with online-met partners (Coleman, Horvath, Miner, Ross, Oakes, & Rosser, 2010). This is perhaps because HIV-positive men conceptualize the Internet as an efficient tool for finding HIV-positive or 'poz-friendly' partners (Cruess et al., 2016; Elford, Bolding, & Sherr, 2001; Heijman et al., 2016).

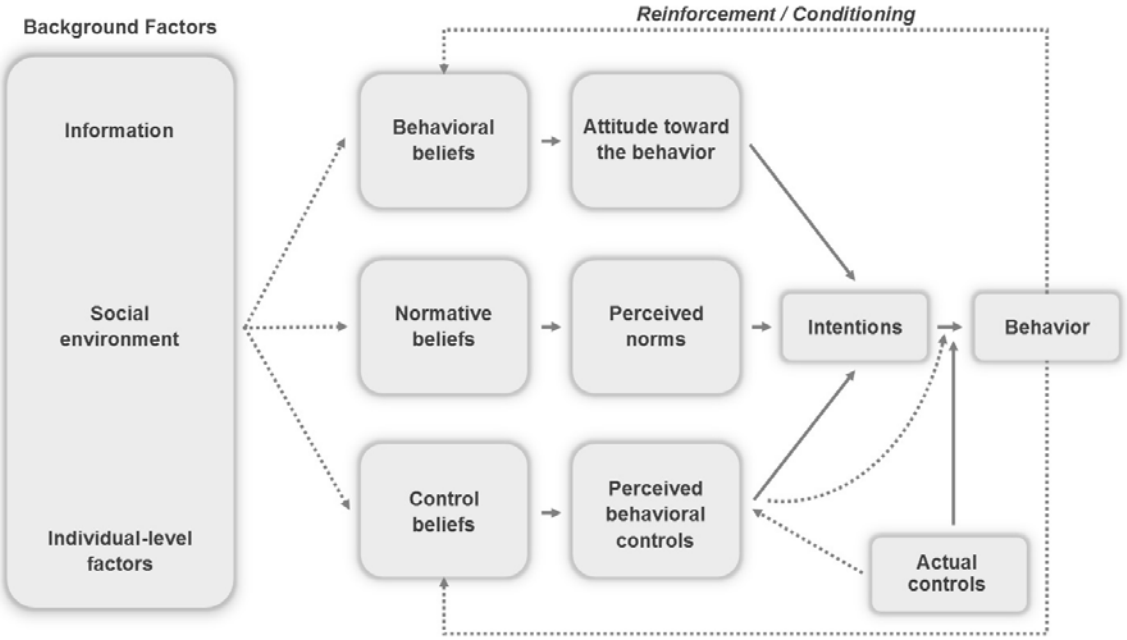

Figure 1. The Reasoned Action Approach

Similarly, ethnic minorities (Coleman, Horvath, Miner, Ross, Oakes, & Rosser, 2010), men living in rural areas (Kakietek, Sullivan, & Heffelfinger, 2011), men with high cognitive escape (D. McKirnan, Houston, & Tolou-Shams, 2007), and men with high sexual sensation seeking (Horvath, Beadnell, & Bowen, 2006) apparently turn to the Internet to increase their supply of potential sexual partners—perhaps out of a desire to escape the normative judgements surrounding certain stigmatized behaviours (Berg, 2008; da Silva & Iriart, 2012; Douglas & Calvez, 1990). Together, these findings emphasize an important interaction between individual-level factors and the social environments in which they exist.

Behavioural, Normative, and Control Beliefs. Considering the role of background factors, it is important to recognize that they are not simply isolated person-level characteristics, but rather represent a range of diverse cultural and social influences that shape GBM's behavioural, normative, and control beliefs (Douglas & Calvez, 1990).

Therefore, their use of the Internet, as evidenced by the findings summarized earlier, likely plays an important role in shaping the "culture" of these venues. Indeed, this suggests that the association between OSS and CAS is at least partially mediated by its appeal to GBM who seek sex across more venues and who have more sexual partners (Grov et al., 2007; Jenness et al., 2010). Further, previous findings suggest that the sexualized nature of online venues appears to impact whether GBM use condoms at these venues (Ostergren, Rosser, & Horvath, 2011). Per Ostergren et al. (2011), GBM who seek sex online are more likely to attribute CAS to personal choice, mutual agreements, and getting caught up in the heat (or, I might suggest, the fast-paced, rigid, and goal-directed sexual scripts associated with these encounters) of the moment, while GBM rationalized CAS during offline encounters as a matter of relationship characteristics or substance use.

Contextualizing these findings, other studies have shown that GBM feel less personally responsible for protecting online partners compared to those met in social settings (O'Leary, Horvath, & Simon Rosser, 2013). Research has also shown that GBM believe that online-met partners are more likely to disapprove of condom use (van den Boom et al., 2015). This suggests that the increased risk associated with online venues emerges from how GBM view these settings (Race, 2015; Ross, Rosser, McCurdy, & Feldman, 2007a) and whether or not they are confident in their ability to use condoms with online-met partners (Bandura, 1977; Klein, 2014).

Behavioural Intention. Ultimately, the combined influence of incompatible social norms, reduced self-efficacy, and more accepting attitudes towards CAS is hypothesized to result in decreased intention to use condoms. Indeed, intentions to engage in condom use have been shown to approximate condom use reasonably well (Albarracín et al., 2001; P. Sheeran & Orbell, 1998; Widman, Golin, & Noar, 2013) and the intention to meet partners for sex is associated with greater CAS incidence (Horvath et al., 2006). Considering that the Internet is used by some to intentionally seek out condomless sex (Berg, 2008)—perhaps using seroadaptive risk management strategies to reduce risk—it is not unsurprising that every study I've mentioned found that OSS was associated with CAS for at least some GBM under some conditions. This highlights the need to think beyond traditional stratifying variables and consider how unmeasured characteristics might shape the preferences of various sub-groups of GBM within gay communities.

Behavioural Controls. With that said, intentions do not perfectly account for the total variance in behaviour (Paschal Sheeran, 2002). Indeed, control factors may inhibit GBM from engaging in the sexual behaviour they prefer. While the lack of publicly provided condoms in venues where online-initiated events might take place may very well be an obstacle for condom use during these encounters (Ostergren et al., 2011; Shacham, Nelson, Schulte, Bloomfield, & Murphy, 2015), other, less obvious control factors have also been identified. For example, person-level characteristics like HIV status, ethnicity, and rural residence, in addition to acting as background factors, may also act as controls. Indeed, because the Internet offers an easily accessible supply of partners, promotes serodisclosure, and prioritizes physical features over other social cues, GBM are more empowered to discriminate as they filter through GBM based on physical or serological characteristics (Paul, Ayala, & Choi, 2010). This market-like devaluation of marginalized sub-groups of GBM may therefore limit the types of partners and behaviours that these men can find via the Internet—potentially exposing them to greater risk than they might otherwise intend (Klein, 2014; Paul et al., 2010; Pulerwitz & Dworkin, 2006).

Reinforcing Effects. The predictors of greater relative CAS in online environments do not stop at the end of each sexual encounter. RAA predicts that the social and cognitive processes underlying intention and behaviour are reinforced through behaviour (Fishbein & Ajzen, 2011). Indeed, as GBM engage in risk, especially if the outcomes are pleasurable and amenable, the behaviour becomes conditioned as part of a repertoire (a term originally used by behavioural psychologists to describe the pattern of learned practices exhibited by an individual). As reported by one study, GBM who experienced limited success in meeting partners online practiced safer sex, while those with greater success “were the most at risk regarding Internet cruising and negative sexual health outcomes” (Moskowitz & Seal, 2010, p. 7). This feedback loop between self-efficacy (i.e. perceived ability or inability/appropriateness or inappropriateness to use condoms – informed by one’s behavioural, normative, and control beliefs) and actualized sexual behaviour in online environments may therefore accentuate the risks associated with these venues, with such accentuation occurring primarily through a process of reinforcement learning (e.g., reward-based conditioning; J. A. Kelly & Kalichman, 1998).

Summary. Interpreted with respect to RAA, these studies suggest that the relationship between OSS and CAS is complex and multifaceted. Indeed, it appears this relationship

emerges through the interaction of both self-selection and accentuation—the two prevailing hypotheses proposed by Liau et al. (2006). The first step in this process occurs in the *background*, as online venues are social constructs as sexualized contexts (Race, 2015)—attracting high-risk GBM who use these venues for the explicit purpose of finding sexual partners (self-selection hypothesis). At this point, GBM may or may not *intend* to engage in CAS (Berg, 2008). However, because behavioural and normative beliefs construct the meaning that online environments have for GBM – particularly as places of eroticism (and perhaps at the expense of safety and caution) GBM may perceive potential partners in online venues as being antagonistic to condom use (whether or not this is actually the case; Klein, 2014; Ostergren et al., 2011). This destabilizes online sex seekers' *intentions* to use condoms, perhaps by attacking their self-efficacy (Miner, Peterson, Welles, Jacoby, & Rosser, 2009). Therefore, GBM ultimately engage in greater rates of CAS with online-met partners. Then, after having engaged in CAS—especially if it was a positive experience with no adverse health consequences—RAA suggests that these behaviours become *reinforced* into the repertoire of online-sex seekers (Fishbein & Ajzen, 2011; Moskowitz & Seal, 2010)—thus accentuating the risk in these environments. With that said, few studies have leveraged RAA to investigate condom use within the context of online events. However, those which have suggest it is an appropriate model—explaining up to 70% of the variation in condom use intentions with online-met partners (Kok, Hospers, Harterink, & De Zwart, 2007).

1.3. Research Gaps

Inherent in the reasoned action approach is a subtle recognition of the influence that background factors (i.e., defined by the reasoned action approach as those which give rise to behavioural, normative, and control beliefs) have in shaping online environments and the associated behaviours that are enjoyed in proximity to these online worlds. Indeed, while behavioural, normative, and control beliefs may very well be the most immediate predictors of sexual behaviour, researchers must be careful to not ignore the role that social influences play in shaping personal decisions (Adolphs, 2009; Choudhury, 2009; Skuse & Gallagher, 2009). To do so would be short-sighted. With that said, to my knowledge, the relationship between social and sexual behaviour has not been fully examined particularly since – and with respect to – the emergence of the

Internet. This is a vital research area given the proliferation of studies which argue that recent changes in GBM's patterns of online and offline connectedness have begun to transform their participation in events and venues where public health campaigns have traditionally been positioned to promote sexual health and HIV prevention (Goltz, 2014; Holt, 2011; B. C. Kelly, Carpiano, Easterbrook, & Parsons, 2014; Rowe & Dowsett, 2008; Simon Rosser, West, & Weinmeyer, 2008; Zablotska, Holt, & Prestage, 2012a). Furthermore, as the Internet is increasingly used for HIV prevention, these interventions must take into account the dynamic interplay between online and offline factors which until only recently have remained relatively obscure.

However, while the rise of the Internet may very well be an important driver of changing social and sexual behaviour among GBM – as some have assumed – some evidence suggests that its effects may be overstated and that broader trends towards greater individualism better account for these shifting values (Wellman, 2001). Indeed, it should be noted that there has never been a universal pattern of community attachment among gay men, and that changes observed in modern communities may simply reflect the decline of only a single stereotypical form of GBM community participation. For example, **Figure 2** shows an intriguing correlation between the spatial prevalence of gay app use (measured using Grindr) and the traditionally defined spatial distribution of GBM (Card et al., 2017, In Review). In particular, inexplicably high app-users density in the West End (i.e. Metro Vancouver's traditional "gay neighbourhood") calls into question whether online sex seeking is a cause of community decline, a hallmark of community connectedness, or both. In other words, it remains to be seen whether online community venues supplant or supplement traditional venues (Jenness et al., 2010).

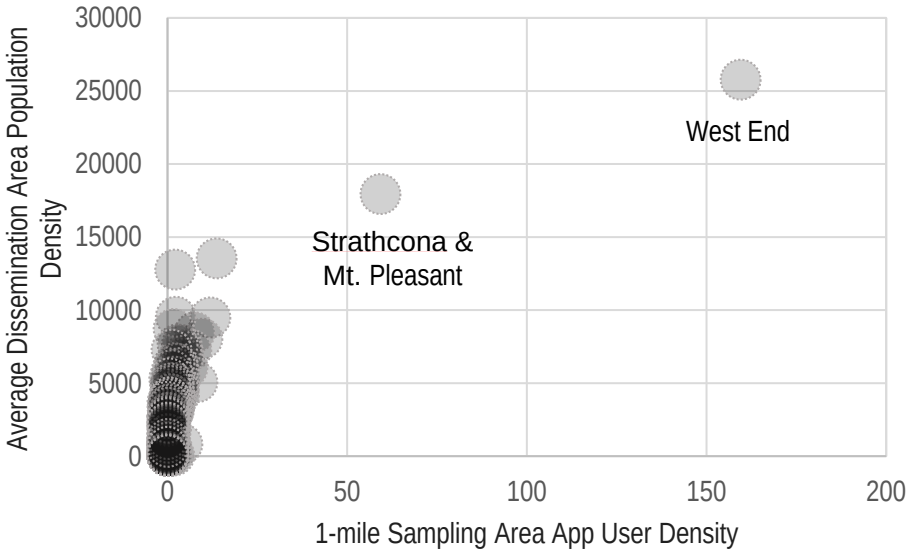

Figure 2. Population Density and Grindr User-Density in Metro Vancouver (Card et al. 2018, In Review)

Underscoring this ambiguity, **Figure 3,** shows trending declines in the proportion of Vancouver GBM who feel that community connectedness is important to them ($p < 0.001$), visit gay bars and clubs at least monthly ($p < 0.001$), go to gay group meetings ($p < 0.001$), read gay news media ($p < 0.001$), and seek sex online ($p < 0.001$).[1] Meanwhile, there were no significant changes in the proportion of men attending the annual gay pride parade ($p = 0.371$) or who spent more than 50% of their social time with other GBM ($p = 0.600$) and there was even an increase in the proportion of men living in the West End ($p = 0.013$). While it is difficult to parse out age, period, and cohort effects for these trends, declining participation in both online and offline venues suggest that OSS is not necessarily driving declining participation in other venues and may in fact be subject to the same factors contributing to lower participation in other venues.

[1] All indicators were measured over the past six months (P6M), at study visits taking place between 2015 and 2017 except for pride parade attendance (P12M) and importance of community connectedness (Current). Trend significance for all models was determined using generalized linear mixed effects models for all visits with visit number as the primary explanatory variable, person and RDS chain as fixed effects, and age and relationship status as confounder variables.

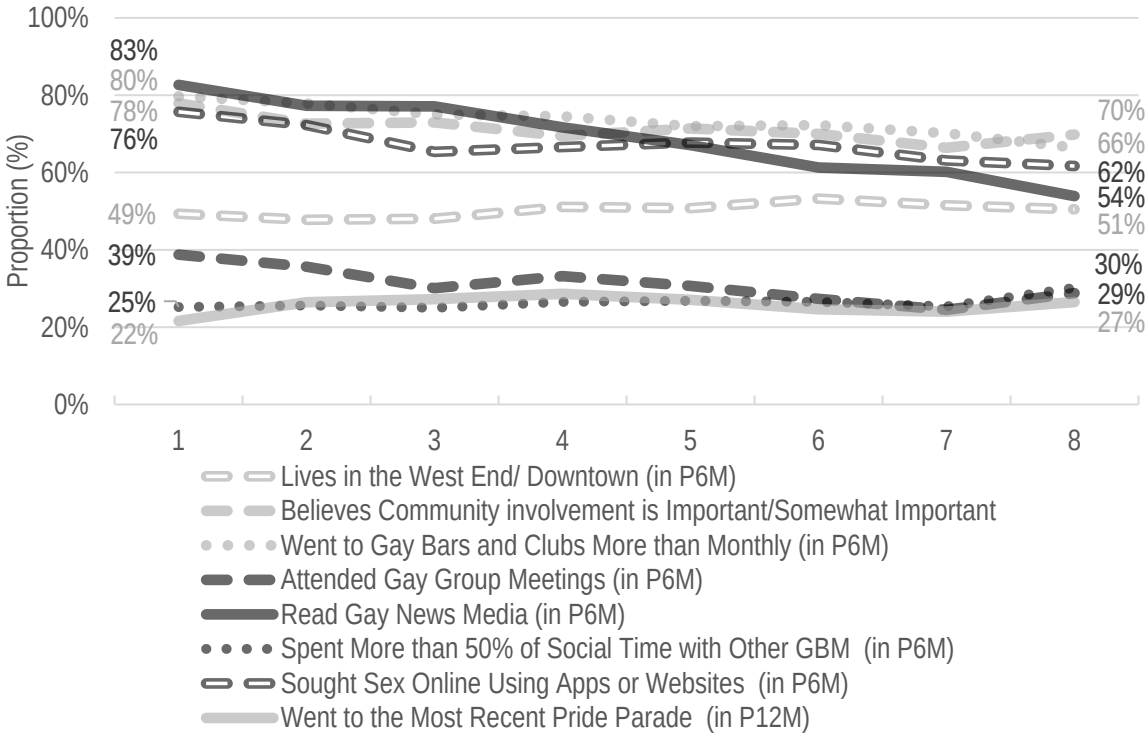

Figure 3. Longitudinal Trends in Community Connectedness Indicators, by Visit

1.4. Specific Aims

Based on the evidence summarized above, improving our understanding of online sex seeking and its influence on GBM's sexual behaviour will enable us to better serve GBM communities by guiding the development of interventions which best meet the context-specific needs of online environments. As such, the overall goal of this thesis was to examine the relationship between online and offline patterns of community connectedness, assess to what extent these interpersonal factors facilitate differential patterns of risk behaviour among GBM who seek sex online, and explore the potential mechanisms that give rise to these differential patterns of risk behaviour. With this goal in mind, each of the following chapters in this thesis are organized around one of the following four specific aims:

(i) To explore the existing literature with the goal of better understanding the association between GBM's social behaviour and their use of apps and websites to find sexual partners (Chapter 2).

H_a: Existing literature shows that online sex seeking is negatively associated with community and social connectedness among GBM.

(ii) To describe patterns of online and offline connectedness among GBM (Chapter 3).

H_a: Online sex seeking is characterized by a group of highly connected users and a group of less-connected users; GBM who don't seek sex online will primarily be highly connected.

(iii) To identify factors associated with condomless anal sex within the context of sexual encounters between GBM who first met online (Chapter 4).

H_a: Community connectedness has a protective affect (in terms of condom use) among GBM who sought sex online.

(iv) To characterize the pathways by which various social factors and cognitive risk perceptions shape GBM's behaviour in online and offline environments (Chapter 5).

H_a: The relationship between online sex seeking and condomless anal sex is explained by lower collectivism and altruism and higher sexual sensation seeking among GBM who seek sex online.

1.5. Description of Cohort

1.5.1. Overview of Study

The aims of this study were completed using data from the Momentum Health Study, a longitudinal prospective cohort investigating the impact of expanded access to antiretroviral therapy. The Momentum Cohort is maintained by the BC Centre for Excellence in HIV/AIDS under the supervision of Dr. Robert S. Hogg. Participants in the Momentum Health Study were recruited using respondent-driven sampling (RDS; Heckathorn, 1997). In preparation for RDS implementation, formative research (community mapping), focus group discussions, and key-informant interviews were used to better understand and define the Vancouver GBM population (Forrest et al., 2014). In February 2012, 10 seeds were selected from various community venues. Each seed was given three RDS vouchers and instructed to recruit other participants in their social and sexual networks. After initial slow uptake the number of vouchers per seed was increased from three to six, and eventually initial seed recruitment expanded to 119 participants using geosocial networking advertisements. Recruitment was closed in February 2014. Participation was restricted to those who (1) gender-identified as a man, regardless of sex at birth, (2) were 16 years or older at time of enrollment, (3) reported having had sex with a man in the past six months, (4), received an RDS voucher for participation in the study, or were selected as an initial “seed”, and (5) were able to complete a questionnaire in English. Eligible participants from the initial Momentum cross-sectional study were invited to participate in a four-year cohort with follow-up questionnaires and clinical examinations every six months. Participants were contacted by email and phone every six months and a time was scheduled to visit the Momentum Study Office in Vancouver’s downtown West End. At each follow-up, study participants completed a computer-administered questionnaire, and underwent a rapid HIV test, syphilis test, hepatitis C serology, urine and anal swab screens for *N. gonorrhea* and *Chlamydia trachomatis* and provided consent to allow researchers access to health services databases in the province. The Momentum questionnaire collected survey responses using computer-assisted self-administered interviews, and was divided into six main sections: Demographics, HIV Testing Behaviour, Community Participation, Sexual Behaviours and Practices, Information about the Participant’s Sexual Partners and Event-Level Sexual Encounters, Attitudes and Beliefs, Substance Abuse, and

Mental Health. For HIV-negative men the study concluded after eight follow-up visits per individual. For HIV-positive men, data collection is ongoing as part of the trans-Canadian Engage Study. For descriptive purposes, **Figure 4** shows the spatial distribution of Momentum participants relative to the spatial distribution of the general population.

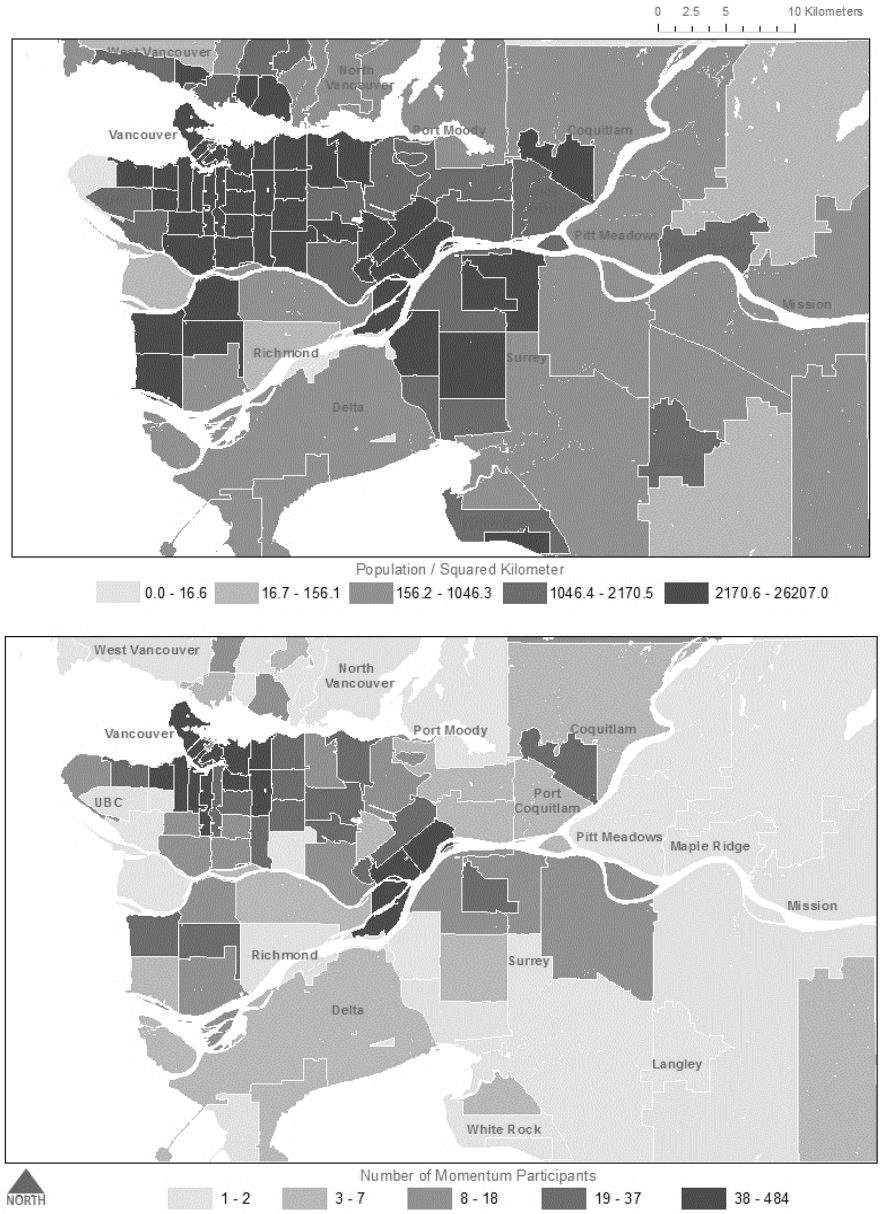

Figure 4. Distribution of the General Vancouver Population (Top) and Participants Enrolled in the Momentum Health Study (Bottom), Coloured by Quantiles. (Card et al. 2018, Preliminary Data).

1.5.2. Strengths of Momentum Health Study

A number of factors make the Momentum Health Study a suitable framework for this thesis. First, by using respondent-driven sampling (RDS) it provides population-based estimates with confidence intervals. Secondly, the use of computer-assisted self-surveying helps to reduce interviewer bias and better allows participants to respond to questions regarding sensitive topics. Third, the collection of event-level and period prevalent self-reported data allows for analyses that are representative of behavioural events over the past six months, and the associations between these behaviours as exhibited by recent event-specific sexual encounters. Finally, as the study does not rely on venue-based sampling, it provides a new source of data that, at least to my knowledge, has not been previously used in studies assessing GBM's online and offline interpersonal connectedness.

1.6. Thesis Outline

This manuscript-based thesis presents three stand-alone chapters, bookended with introductory (Chapter 1) and concluding (Chapter 6) chapters. As such, some of the information presented in each chapter is repetitious. However, each chapter contributes to the thesis as follows:

- **Chapter 1** introduces the epidemiological consideration of this work — namely the risk associated with online sex seeking — and outlines my specific aims.
- **Chapter 2** provides the theoretical rationale for this work and reviews published literature which has previously assessed the relationship between online sex seeking and community connectedness.
- **Chapter 3** uses latent class analysis to examine patterns of online and offline connectedness among GBM.
- **Chapter 4** uses longitudinal event-level data to examine the relationship between interpersonal factors and condom use during reported events between GBM who initially met online.
- **Chapter 5** examines the psychosocial pathways by which social phenomena contribute to increased risk-taking among GBM.
- **Chapter 6** summarizes the findings of chapters 2 through 6 and discusses the implications of this work.

Chapter 2.

Literature Review

2.1. Synopsis

In the previous chapter, I proposed that our understanding of the association between OSS and CAS can be improved by considering how sociocultural influences might shape GBM's sexual behaviour. However, this raises an important question: Namely, whether the social behaviours of GBM who seek sex online differ from those who do not. To address this question, I used the PubMed and Web of Science databases for studies examining Internet use and connectedness among gay and bisexual men. Framing this analysis, I introduce Douglas's Cultural Theory of Risk (Douglas & Calvez, 1990), which draws an explicit association between sociocultural influences and risk perceptions. Within this context, the findings presented in this chapter suggest that Internet use may be associated with lower odds of identifying as gay, lower community attachment, and lower social embeddedness. However, inconsistency in results suggests that sampling, instrumentation, or omitted-variable bias may be obscuring important trends. Interpreting these findings with respect to Douglas's cultural risk theory and harkening back to the framework laid out in the earlier chapter, I argue that the attractiveness of the Internet to individuals with lower collectivism has served as a driving force for the association between OSS and CAS. Further, these findings highlight cultural heterogeneity within the GBM communities and the need for HIV prevention that is tailored, targeted, and attuned to the divergent cultural values of GBM who connect with other GBM in distinct settings.

2.2. Background

In the United States, gay, bisexual, and other men who have sex with men (GBM) account for an estimated two-thirds of all new HIV cases and represent half of all persons living with HIV (Centers for Disease Control and Prevention, 2015). Similar trends are apparent in Canada, where in 2011, GBM accounted for approximately half of HIV cases (Public Health Agency of Canada, 2014). Responding to this epidemic, public health professionals have relied on community-based organizations to promote social

norms amenable to a variety of health outcomes—particularly condom use. As such, community-driven prevention has become an important instrument in reducing HIV risk among GBM.

However, researchers tracking widespread social change have wondered whether gay communities continue to play a vital role in the lives of GBM (Rowe & Dowsett, 2008). For example, sociological examinations of 21st Century communities suggest that they have transitioned from a pattern of tight-knit collectivist groups to one of 'networked individualism' (Wellman, 2001). Among Australian GBM, researchers have documented a shift away from geographically defined and institutional communities towards less formal personal networks (Holt, 2011).

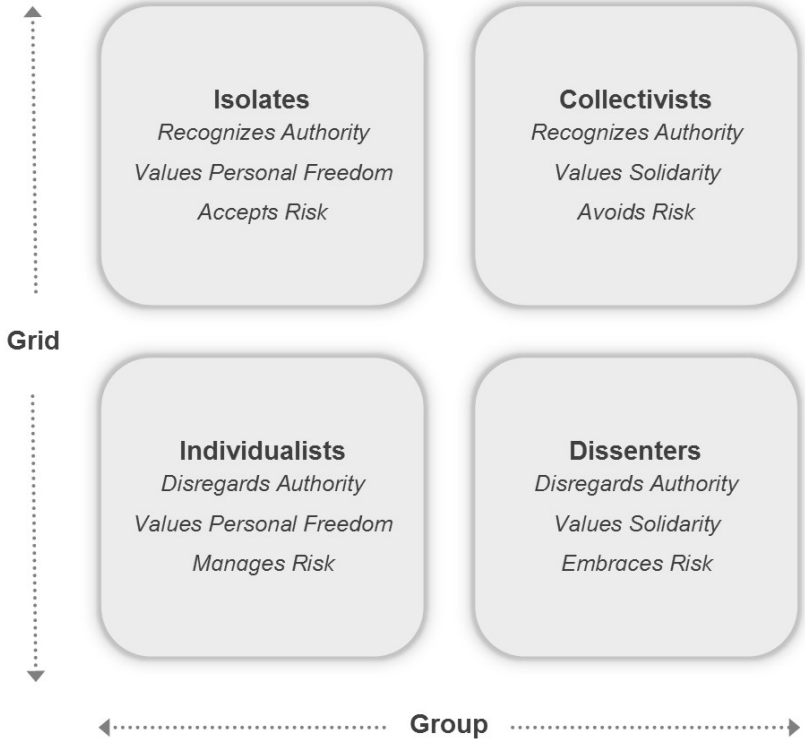

Figure 5. Cultural Risk Theory

Illuminating the effects this shift might have on HIV prevention, Douglas's (1976) cultural risk theory argues that individual risk perceptions and preferences are developed within and reinforced by the social networks in which individuals exist. Cultural risk theory therefore defies public health approaches that frame prevention as merely an act of individual risk avoidance. Instead, it asserts that risk perceptions are an emergent

property of the cultural values of individuals, which are in turn a product of the ways social groups are organized. Theoretically, in insular communities, social structures are stable and cultural values are self-perpetuating. In other words, the values of individuals are shaped by their community's values, and, in turn, individuals act to reinforce these values—thus upholding the social order. Of course, neither communities nor individuals exist in isolation: social structures change, values ebb and flow, groups form and reform in an iterative, complex, and dynamic process.

Cultural risk theory attempts to provide a framework to help us understand these changes using a model of constrained relativism, wherein subjective positions are mediated by cultural biases shaped by a limited number of organizational forms. Particularly, Douglas (1976) conceptualizes communities as being organized along two primary factors: "group" and "grid." Situated on a two-dimensional continuum (**Figure 5**), "group" measures the social cohesion of a community on the horizontal axis and "grid" measures the social stratification of a community on the vertical axis. Douglas argues that these two factors model not only the social organization of communities, but also their cultural values and the risk beliefs of individuals belonging to these communities. Applying this analytic approach to GBM at the height of the HIV epidemic, Douglas & Calvez (1990) describe four archetypical social structures and explain how the cultural values embodied in these structures come to shape GBM's perceptions towards HIV risk and prevention:

- **Hierarchists***:* High-group, high-grid communities are collectivistic and stratified. Their social cohesion leads to "strong views on correct norms of behaviour" (p. 447) and gives them a sense of safety in solidarity. As such, they are risk averse and rely on social norms to guide their behaviour. *Hierarchists* emphasize the boundaries of their group—who is in and who is out. The social stratification of these groups also encourages them to rely on the expertise of professionals and specialists. This reinforces a sense of organization and social order. Community structures are therefore formalized and often materially prescribed by geography or social function.

- **Dissenters***:* High-group, low-grid communities are collectivistic and egalitarian (Douglas & Calvez, 1990). With respect to gay culture, they are the standard bearers—resistant to a mainstream that has rejected them via their sexuality. As

with *hierarchical cultures*, their members are strongly bound together and there is still a concern for who is part of the group and who is not, but individuals are equal. To them, there is no justification for hierarchy. As such, these communities rely on "homespun, folkloristic remedies" (p. 452), or what I might call "community-grounded" approaches. Solidarity between group members reinforces internal norms, even, or especially, when these norms run counter to the moral reasoning of the mainstream. In many ways, they are defined by their dissent, and therefore embrace risks, as judged by the mainstream, as a core feature of their identity and social bond with one another.

- **Individualists***:* Low-group, low-grid communities are individualistic and egalitarian. Their members "do not belong to any exclusive groups" (p. 448) and they are not bound by social norms. In fact, their individualism and egalitarianism gives rise to an "entrepreneurial" spirit and a sense of scepticism towards authority. Therefore, while *individualists* are risk-takers, they are also early adopters of novel, unproven prevention strategies. Their patterns of connectedness reflect opportunism and avoidance of normative restrictions.

- **Isolates***:* Low-group, high-grid communities are individualistic and socially stratified. This combination creates a sense of isolation. Regarding connectedness, they exhibit little social attachment to GBM communities. They are not driven by social norms, and feel isolated by their social stratification—leading to a sense of helplessness. As such, *Isolate* communities are sometimes described as fatalistic, and may therefore do little to prevent themselves from acquiring HIV.

According to Douglas & Calvez (1990), "If scientific information does not diffuse smoothly and quickly [within a society], it is because of its value in the cultural struggle" between these groups (p.453). Douglas's cultural risk theory, therefore, explains the politicization of risk, knowledge, and science, and gives insight into why some men define themselves as "risk-takers," "barebackers" or "bug chasers" (Balán et al., 2012; Grov & Parsons, 2006). Further, it rationalizes why men choose novel, unproven, or even disproven risk management strategies over those which are embraced by the mainstream (Berry, Raymond, Kellogg, & McFarland, 2008a). In other words, cultural risk theory describes why, despite the promulgation of objective inquiry via the scientific

method, risk remains politicized—subject to the subjective, in contradiction to so-called 'rational choice theories.'

However, with the emergence of the Internet two decades ago, it is unclear how changes in the lives of GBM might be impacting the cultural values of gay communities. Indeed, since the early 1990's, the Internet has become an increasingly popular venue for GBM (Jennings et al., 2015). According to Weinrich (1997), the internet's very origins, in the suburbs of San Francisco, made it sort of a virtual gay neighbourhood, where GBM could explore their sexual identity, contest their social marginalization, connect with friends, and build communities (Grov, Breslow, et al., 2014; Harper, Serrano, Bruce, & Bauermeister, 2015). In particular, the Internet has also provided a new space for GBM to find sexual partners, (Bolding, Davis, Hart, Sherr, & Elford, 2007; Jennings et al., 2015; Menza, Kerani, Handsfield, & Golden, 2009), likely reducing the relative advantage of traditional gay venues and community groups.

If, in fact, risk perceptions work as Douglas asserts they do, the changes in the social organization and cultures of GBM communities would have important implications for current and future HIV prevention. Indeed, if the individualistic and egalitarian digital frontier has in anyway degraded collectivistic cultural centres, then traditional public health strategies targeting high-group communities may lack efficacy. In other words, if the Internet is reshaping the social bonds of GBM, as some have suggested (Goltz, 2014; Hightow-Weidman et al., 2014; Lewis et al., 2015; Miller, 2015; Rowe & Dowsett, 2008; Simon Rosser et al., 2008; Zablotska, Holt, & Prestage, 2012b), then it may be also reshaping their view of risk, HIV, and themselves. As such, the present review explores the literature examining the relationship between Internet use and connectedness among GBM with the aim of better understanding the impact that the Internet has had in shaping how GBM relate to their communities and the values that underlie these relationships.

2.3. Methods

In February 2017, I searched the PubMed and Web of Science databases for papers relating to MSM identity (i.e., same-sex, men who have sex with men - MSM, homosexual, gay, men who use the Internet to seek sex with other men - MISM), connectedness (i.e., social, cultural, community, peer, group, network, venue, friends,

attachment, identification, participation, attendance, involvement, engagement, loneliness, isolation), and Internet use (i.e., online, Internet, apps, web, cyber, smartphone, chat). Duplicate results were removed by matching digital object (DOI) and PubMed identifiers (PMID). The titles and abstracts of each article were reviewed and conspicuously irrelevant articles were excluded. Inclusion criteria restricted review to articles that sampled North American GBM to examine quantitatively the association between Internet use and community attachment. Articles with abstracts meeting these criteria, published at any point in time, were reviewed more thoroughly, and ineligible articles were removed.

2.4. Results

Figure 6 provides an overview of the article selection process undertaken in this review. In brief, the PubMed and Web of Science databases returned 2,590 unique articles. Of these, a total of 30 studies were included.

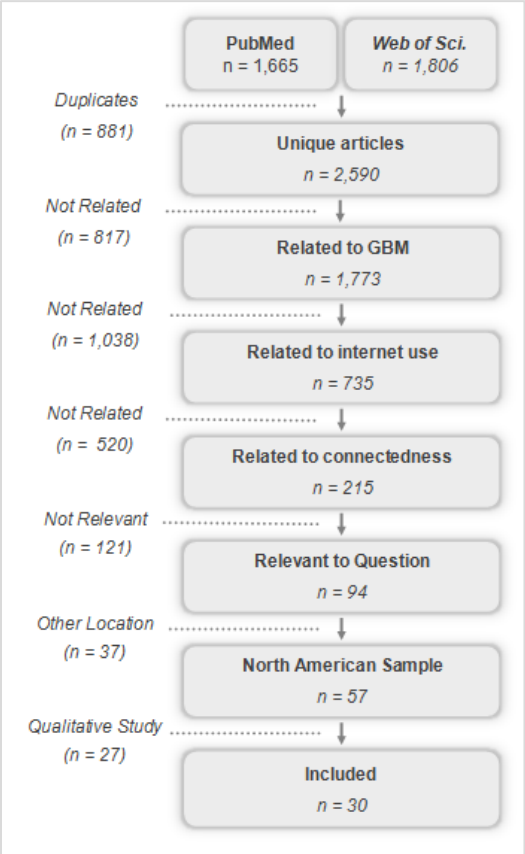

Figure 6. Literature Search for Studies Related to Internet Use and Community Connectedness

Table 1 provides an overview of included articles and the reported prevalence of Internet use. Most studies leveraged venue-based sampling to examine the covariates of online sex seeking or compare differences between online and offline samples. Over time, the proportion of GBM who reported meeting partners online increased. Regarding measures of connectedness, a variety were used, including measures of identity, community attachment, social embeddedness, geographic residence, and venue patronage.

Table 1. Studies Examining Internet Use and Social Behaviour

Study	Location	Years	Sampling	N	Measure of Internet Use & Prevalence		
					Variable	Recall	%
Hirshfield (2004)[2]	United States	2001	Online	2,916	Met online partners	P6M	80
McKirnan (2007)[2]	Chicago, Illinois	2001	Offline (varied)	817	Online sex seeking	Ever	36
Rhodes et al. (2002)[1]	Birmingham, Alabama	≤2002	Online and offline (bars)	381	-	-	-
Smith et al., (2006)[2]	Southern California	2002-2005	Offline (clinics)	194	Online sex seeking	P12M	70
					% of events initiated online	Last 3	37
(Fernández et al., (2007)[1]	Miami-Dade, Florida	2003-2004	Online and offline (varied)	566	-	-	-
(Chiasson et al., (2007)[2]	United States/Canada	2003-2004	Online	1683	Met online partners	Ever	82
					Met online partners	Last 1	51
Menza et al. (2009)[2]	Seattle, Washington	2003	Random Digit Dialing	400	Met anal sex partner online	P12M	19
		2006		400	Met anal sex partner online	P12M	29
Knapp Whittier et al. (2004)[1]	United States	≤2004	Online and offline (CBO)	551	Met online partners	P2M	54
(Ogilvie et al., (2008)[2]	Canada	2004	Offline (pride festivals)	2,312	Sought sex online	P12M	33
Garofalo (2007)[2]	Chicago, Illinois	2004-2005	Offline (varied)	270	Online sex seeking	Ever	68
					Met online partners	Ever	48
Kakietek et al. (2011)[2]	United States	2004-2005	Offline (pride festivals)	1,243	Met online partners	P12M	47
Kelly et al. (2012)[2]	New York/New Jersey	2005	Offline (gay expos)	661	Met online partners	P3M	87
Horvath et al. (2008)[2]	United States	2005	Online	770	Met online partners	P3M	85

Study	Location	Years	Sampling	N	Measure of Internet Use & Prevalence		
					Variable	Recall	%
Wilkerson et al. (2010)[3]	United States	2005	Online	2,577	Online information seeking	Ever	76
Reisner et al., (2009)[2]	Massachusetts	2007	Offline (varied)	214	Met online partners	P12M	36
Kerr et al. (2015)[2]	San Francisco, California	2007	Offline (bathhouse)	459	Met online partners	P3M	55
Jenness et al., (2010)[1,2]	New York, New York	2008	Offline (VBPS)	479	Met online partners	P12M	28
Downing (2012)[2]	United States	2008	Online and offline	112	Frequent online sex seeking	P1M	52
White et al. (2013)[2]	Boston, Massachusetts	2008	Respondent-driven sampling	197	Met online partners	P12M	20
Veinot et al. (2013)[2,3]	Southeastern Michigan	2008-2010	Online and offline (varied)	194	Daily Internet Use	P12M	99
					Online information seeking	P12M	68
					Met online partners	P12M	37
Grov, (2011)[1]	United States	2009-2010	Online and offline (bars/baths)	601	-	-	-
Grov & Crow, (2012)[1,2]	United States	2009-2010	Online and offline (bars/baths)	592	Most common venue	P3M	46
Jennings et al., (2015)[2]	Baltimore, Maryland	2009-2014	Offline (clinics)	412	Met online partners	P12M	38
Hernandez-Romieu et al., (2014)[1,2]	Atlanta, Georgia	2010-2012	Online and offline (varied)	803	Used Facebook	P1M	66
					Met online partners	P1M	60
Grov et al. (2014)[1,2]	United Stat	2010-2012	Online and offline (varied)	147	Online sex seeking	P3M	84
Beymer et al., (2014)[2]	Los Angeles, California	2011-2013	Offline (clinics)	7,184	Met online partners	P12M	54
Phillips et al., (2014)[2]	Washington, DC	2011	Offline (VBPS)	379	Online sex seeking	P12M	64
					Met online partners	P12M	24
Noor et al. (2014)[2]	United States	2011	Online	5,047	Met online partners	P3M	87

Study	Location	Years	Sampling	N	Measure of Internet Use & Prevalence		
					Variable	Recall	%
Broaddus et al., (2015)[2]	United States	2011	Offline (varied)	205	Used social media	-	83
					Met online partners	P3M	53
Jennings et al., (2015)[2]	Baltimore, Maryland	2009-2014	Offline (clinics)	412	Met online partners	P12M	38
	Vancouver, Canada	2012-2014	Respondent-driven sampling	774	Online sex seeking	P6M	76

Relevance: [1] Online vs. Offline Sampling; [2]Seeking sex or meeting partners online; [3]Seeking information online. Notes: P1M = Past 1 month, P2M = Past 2 months, etc.; VBPS = Venue-based probability sampling

2.4.1. Sexual Identity

A number of studies suggested that Internet use was associated with non-gay-identification (e.g., heterosexual or bisexual identity; Chiasson et al., 2007; Fernández et al., 2007; Grov, 2011; Grov & Crow, 2012; Grov, Rendina, et al., 2014; Knapp Whittier et al., 2004; Rhodes et al., 2002), or non-disclosure of sexual orientation (D. McKirnan et al., 2007; Wilkerson et al., 2010). Other studies reported contradictory findings (Card, Lachowsky, Cui, Shurgold, et al., 2016b; Phillips et al., 2014; D. M. Smith et al., 2006; White et al., 2013) or reported that the association between internet use and gay-identification was not significant (Broaddus et al., 2015; Horvath et al., 2008). Jenness et al. (2010) found that the proportion of men who identified as gay did not differ between men who had met partners only online or only offline but was significantly higher among men who met partners at both venues (77% vs. 75% vs. 89%, $p = 0.02$).

2.4.2. Community Attachment

Three studies found that Internet use was associated with lower attachment to the GBM communities (Fernández et al., 2007; Grov, 2011; Grov, Rendina, et al., 2014). However, Veinot et al. (2013) reported that GBM communitiy involvement was positively associated with using the Internet at least several times a day ($r = 0.153$, $p = 0.040$) and using the Internet to find health information ($r = 0.302$, $p < 0.001$); negatively associated with the amount of time spent chatting with other men online ($r = -0.175$, $p = 0.018$); and not significantly associated with meeting friends online ($r = -0.152$, $p = 0.108$) or online sex seeking ($r = -0.113$, $p = 0.129$). Similarly, Card, Lachowsky, Cui, Shurgold, et al.

(2016b) found that *more frequent* online sex seeking was associated with reading gay news media (> monthly vs. ≤ monthly, Odds Ratio [OR] = 1.72, 95% confidence interval [CI] = 1.18, 2.49) and that men who sought sex online were no less likely to play on gay sports teams (OR = 1.24m 95%CI = 0.73 – 2.09), attend gay specific group meetings (OR = 1.32, 95% CI = 0.84 – 2.07), read gay news media (OR = 0.85, 95% CI = 0.63 – 1.14), or participate in gay pride events (OR = 0.99, 95% CI = 0.73 – 1.34). However, they did have lower collectivism scores *(*i.e., less emotive attachment to gay communities; adjusted OR [aOR] = 0.93, 95%CI = 0.86 – 0.995) and lower communal altruism (Communal Sexual Altruism Scale, (O'Dell, Rosser, Miner, & Jacoby, 2008), OR = 0.76, 95% CI = 0.61 – 0.96).

2.4.3. Social Embeddedness

Kelly, Carpiano, Easterbrook, & Parsons (2012) found that using the Internet to find sexual partners was associated with having a gay centric social network (OR = 2.45, 95%CI = 1.35 – 4.42) but not the intensity of social connectedness with these men (OR = 1.27, 95%CI = 0.93 – 1.75). Card, Lachowsky, Cui, Shurgold, et al. (2016b) found that online sex seekers were less likely to be socially isolated from other GBM (≤25% of social time vs. 26 – 75% of social time, aOR = 1.99, 95%CI = 1.33 – 2.97), were emotionally close to more GBM (OR = 1.01, 95% CI = 1.00 – 1.01), and had more Facebook friends (OR = 1.16, 95%CI = 1.10 – 1.23). Conversely, McKirnan, Houston, & Tolou-Shams (2007) reported that men who used the Internet were more likely to have lower social support scores than men who did not (e.g., "Do you have someone who will…listen to you talk about yourself or your problems?", 38% vs. 29%, p > 0.05). However, Fernández et al. (2007) reported that Internet-recruited men did not differ from community-recruits with respect to loneliness scores (*Lonliness scale, Diaz et al., 2001,* Mean = 2.27 vs. 2.20, p = 0.288) or social connection scores (e.g., *"Are you satisfied by your relationships?",* Mean = 2.40 vs. 2.52, p = 0.477).

2.4.4. Geographic Residence

Knapp, Whittier, Seeley, & St. Lawrence (2004) reported that a lower proportion of Internet respondents than paper respondents lived in metropolitan areas (32% vs. 57%, p < .0001). Conversely, Ogilvie et al. (2008) reported that online sex seeking was associated with residing in an urban metro area vs. a mid-size city (Vancouver vs.

Victoria, aOR = 1.53, 95% CI = 1.02 – 2.30). Meanwhile, Horvath et al., (2008) found that men with online-met partners, offline-met partners, and both online and offline-met partners did not differ with respect to residence in urban areas (21% vs. 24% vs. 27%, ns), suburban areas (25% vs, 27%, vs. 25%, ns), medium cities (29% vs. 24% vs. 27%, ns), small towns (20% vs. 17% vs. 17%, ns), or rural areas (5% vs. 8% vs. 5%, ns). Likewise, Kakietek et al. (2011) found that online sex seeking was not associated with rural or urban residence (p = 0.33). Kelly, Carpiano, Easterbrook, & Parsons (2012) found that using the Internet to find sexual partners was not associated with residing in a gay enclave (OR = 0.85, 95% CI = 0.51 – 1.42).

2.4.5. Venue Patronage

Two longitudinal studies suggested that an increasing proportion of men are using the Internet to find sexual partners (Jennings et al., 2015; Menza et al., 2009). Menza et al. (2009) reported that between 2003 and 2006, the proportion of men who met partners online increased from 19% to 29%, but the proportion of men who met partners at cruising spots decreased from 10% to 4%. It is worth noting, however, that they found no significant change in the proportion of men who reported seeking sex at bars and clubs (24% vs. 25%, p = 0.75), at bathhouses (6% vs. 4%, p = 0.25), in social settings (15% vs. 12%, p = 0.13), or through friends (15% vs. 10%, p = 0.13). Conversely, while Jennings et al. (2015) too found that the proportion of clinic morbidity reports where individuals met partners online increased—from 28% in the first half of 2009 to 36% in first half of 2014— the proportion reporting meeting partners at bars decreased from 72% in the first half of 2009 to 22% in the first half of 2014. Likewise, the proportion of men with partners met at schools, parks, or neighbourhoods decreased from 19% in 2009 to 11% in 2014.

Despite these trends, there was little consistency in the cross-sectional association between using the Internet and patronage of offline venues. Among six studies that assessed overlap in online and offline venue patronage, five reported that the majority of men who met partners online also met partners offline (Hirshfield et al., 2004; Horvath et al., 2008; Jenness et al., 2010; Kerr et al., 2015; Noor et al., 2014a). Several studies reported that Internet users were more likely to visit sexualized venues (Garofalo et al., 2007; Grov, Rendina, et al., 2014; Knapp Whittier et al., 2004; Ogilvie et al., 2008; Reisner et al., 2009), and others found no association (Garofalo et al., 2007; Grov,

Rendina, et al., 2014). Similarly, some studies suggested that Internet users were less likely to frequent bars (Grov, Rendina, et al., 2014; Knapp Whittier et al., 2004), while others found no association (Downing, 2012). Conversely, Card et al. (2016b) found that more frequent online sex seeking (> monthly vs. ≤ monthly) was positively associated with visiting gay bars (OR =1.41, 95%CI = 1.01, 1.97).

2.5. Discussion

2.5.1. Primary Findings

Based on an assessment of these findings, Internet-recruited GBM and those who use the Internet to find sexual partners (herein referred to simply as “Internet users” for lack of a better term) appear to be less likely to identify as gay (vs. bisexual, heterosexual, or other; Grov, Rendina, et al., 2014), and exhibit lower community attachment and social embeddedness (Fernández et al., 2007; Grov, 2011; Grov, Rendina, et al., 2014; D. McKirnan et al., 2007). These findings generally agree with studies conducted in other Western countries (Bolding et al., 2007; Ross, Tikkanen, & Månsson, 2000; Saxton, Dickson, & Hughes, 2013; Zablotska et al., 2012b). However, while online sex seeking has greatly expanded – partially at the expense of traditional venues (Jennings et al., 2015; Menza et al., 2009) – Internet users do not seem to be totally disconnected from these traditional gay venues (Card, Lachowsky, Cui, Shurgold, et al., 2016b; Grov, Rendina, et al., 2014). In fact, studies looking at online and offline patterns of behaviour suggest that the significant majority of Internet users also report visiting offline venues (Horvath et al., 2008; Jenness et al., 2010; Kerr et al., 2015; Noor et al., 2014a).

While traditional community venues may continue to provide a space for high-group (collectivist) orientations, the Internet seems to represent a more individualistic form of community attachment – one that is leveraged by personal satisfaction more than collective adherence. Supporting this assertion, Menza et al. (2009) found that despite increasing Internet use between 2003 and 2006, the only venues that experienced statistically significant decline were cruising locations (e.g., parks; Menza et al., 2009) – a finding I might argue is attributable to the shared purposes of apps and cruising spots (i.e., to find sex, though not necessarily to the exclusion of one’s need for social and cultural inclusion). This would suggest that early growth in online venues came mostly from its popularity among *isolates* and *individualists*; and may not have initially competed

for the attention of *hierarchists* and *dissenting* group members. Between 2009 and 2014, however, others reported that while the proportion of Internet-met partners moderately increased, there was a much larger decline in the proportion of men who reported meeting their partners at bars, schools, parks, and neighbourhoods (Jennings et al., 2015). This suggests that either the proportion of GBM who visit offline venues, or the frequency at which they visit them, has declined. However, these findings do not necessarily suggest that online venues themselves are pulling GBM away from traditional venues. Instead, the decline in offline venues may be the result of a cohort effect, where older GBM are aging out of the bar scene without replacement (Abatiell & Adams, 2011; Harper et al., 2015). Indeed, reports in London suggest that the proportion of GBM who met their first male sexual partner via the Internet dramatically increased from 3% in 1993 to 62% in 2002 (Bolding et al., 2007). This may suggest young GBM are being acculturated into gay cultural life through the Internet—potentially promoting low-group cultural values (or perhaps reflecting them). At the same time, as a lower proportion of GBM are being acculturated into high-group community spaces, the meaning of traditional venues may be changing as the cultural values of their clientele shift.

Indeed, if identity, culture, and risk perception are tied together in the way that Douglas proposes, and the Internet facilitates low-group cultural forms—hosting *individualists* and *isolates*—this would explain why Internet users are less likely to identify as gay or exhibit patterns of community attachment and social embeddedness. Further, this would explain why Internet users are more likely to engage in condomless anal sex (CAS) and choose alternative risk management strategies, such as serosorting or strategic positioning. After all, online gay venues have repeatedly been associated with higher odds of CAS and greater partner frequency (Lewnard & Berrang-Ford, 2014; Liau et al., 2006; Yang, Zhang, Dong, Jin, & Han, 2014b). Further, men who seek sex both online and offline have been shown to engage in the greatest levels of risk (Horvath et al., 2008; Jenness et al., 2010; Kerr et al., 2015). Further, a large body of literature has shown a strong relationship between Internet use and alternative risk management strategies, or even outright disregard for HIV prevention (Balán et al., 2012; Berry, Raymond, Kellogg, & McFarland, 2008b; Grov & Parsons, 2006; P. N. Halkitis & Parsons, 2003; Klein & Tilley, 2012). Together, this evidence suggests that online venues are “riskier” because they attract individuals with cultural orientations that hold lesser esteem for traditional

prevention behaviour—a theory sometimes referred to in the epidemiological literature as *the self-selection hypothesis* (Liau et al., 2006). However, expanding upon the self-selection hypothesis, cultural risk theory may suggest that as more and more GBM become acculturated into gay life, online venues are perpetuating low-group values that might be more amenable to alternative HIV prevention strategies that may not include condoms.

2.5.2. Implications & Future Research

If mainstream health authorities are hoping to continue leveraging online venues to promote HIV prevention, they must be sensitive to their own cultural standing and how their messages will be viewed by GBM with diverse cultural dispositions. Health promotion specialists will need to explore ways of tailoring online messages to the cultural values of a diverse audience; or, perhaps, develop interventions which are more amenable to these values. In the present review, I've argued that the inherent social organization of online and offline venues may play a role in shaping these cultural values. Venue-tailored prevention may therefore provide a way for public health and community leaders to stratify and target these groups. As such, further qualitative and empirical analyses are clearly necessary to examine how the cultural values of GBM might relate to their sexual, social, and risk management behaviour.

2.5.3. Limitations

As with other literature reviews, the present study has several important limitations which should invite scepticism of these conclusions. First, while I have searched earnestly to identify all relevant findings, some relevant data may have been excluded. This is especially possible due to underreporting of non-significant and null findings in the abstracts of published papers. Second, as the results of the studies I reviewed were mixed, it is possible that the relationships discussed here are merely the results of sampling biases or differences in instrumentation. Indeed, venue-based sampling and the very act of asking people to participate in research, may restrict participation to a sample of GBM that is not representative of the cultural and behavioural factors that are explored here. Third, as I have made subjective assessments regarding the relative value of contradictory findings, this analysis is subject to potential reviewer bias.

Readers should also note that the cultural values discussed in the present review exist on a continuum, rather than in discrete theoretical categories. For a fuller discussion on the critique of cultural risk theory see (Tansey & O'riordan, 1999). Further, while the evidence examined in this review lends support for further investigation of Douglas's cultural risk theory, the relationship between patterns of community participation and broader cultural values lacks statistical support. Indeed, the difficulty of operationalizing cultural risk theory for quantitative study is well-documented (Tansey & O'riordan, 1999). Also, the stability of the relationships between cultural categories and risk perceptions developed in the late-1980's may not hold true in contemporary communities. Indeed, as shifts occur in inter-group dynamics, which are essential to cultural risk theory's politicization of risk, the relationship between group-grid cultural forms and specific prevention strategies may be changing. Further, broader societal trends (i.e., mainstream inclusivity of GBM) may be complicating the ways GBM relate to one another and to broader cultural powers.

2.6. Conclusion

With consideration to these limitations, these findings advance a cultural risk theory of Internet use, connectedness, and sexual risk among GBM—meriting further investigation of the relationship between cultural values, patterns of connectedness, and sexual behaviour. In short, I argue that the emergence of the Internet has provided a new space for individualistic cultural values to prosper. As such, the patterns of sexual behaviour observed in online forums differ from those promoted by the established mainstream.

Chapter 3.

Patterns of Online and Offline Connectedness among Gay, Bisexual, and Other Men Who Have Sex with Men

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3.1. Synopsis

In Chapter 2, I reviewed previous research examining the association between online sex seeking and condomless anal sex. Results of this review were largely mixed, with some studies showing lower interpersonal connectedness among GBM who sought sex online and others showing greater interpersonal connectedness. Therefore, the present chapter seeks to provide more nuanced patterns of community and connectedness among GBM enrolled in the Momentum Health Study with the hopes of understanding the factors associated with the patterns of community connectedness. Latent class analysis examined patterns of connectedness including: attendance at gay venues/events (i.e., bars/clubs, community groups, pride parades), social time spent with GBM, use of online social and sex seeking apps/websites, and consumption of gay media. Multinomial regression identified correlates of class membership. A three-class LCA solution was specified: Class 1 “Socialites” (38.8%) were highly connected across all indicators. Class 2 “Traditionalists” (25.7%) were moderately connected, with little app/website-use. Class 3 “Techies” (35.4%) had high online connectedness and relatively lower in-person connectedness. In multivariable modelling, Socialites had higher collectivism than Traditionalists, who had higher collectivism than Techies. Socialites also had higher annual incomes than other classes. Techies were more likely than Traditionalists to report recent serodiscordant or unknown condomless anal sex and HIV risk management practices (e.g., ask their partner’s HIV status, get tested for HIV). Traditionalists on the other hand were less likely to practice HIV risk management and had lower HIV/AIDS stigma scores than Socialites. Further, Traditionalists were older, more likely to be partnered, and reported fewer male sex partners than men in

other groups. These findings highlight how patterns of connectedness relate to GBM's risk management.

3.2. Background

Beginning in the early 1980's, the HIV epidemic swept through gay communities (initially those in North America). In response, community action campaigns focused on promoting condom use to prevent HIV transmission within gay communities (CDC, 2006). By the mid-1990's, however, highly active antiretroviral therapies (HAART) led to significant declines in HIV-related morbidity, mortality, and transmission (Montaner et al., 2014), fundamentally reshaping the epidemic and its consequences for people living with HIV (Centers for Disease Control and Prevention, 1988). After the advent of antiretroviral therapy, reports began to emerge that condom use was declining among gay, bisexual, and other men who have sex with men (GBM; Adam, Husbands, Murray, & Maxwell, 2005), leading some to believe that treatment optimism was contributing to greater HIV risk in this population (Van de Ven, Crawford, Kippax, Knox, & Prestage, 2000). However, wider cultural changes taking place in the 1990's made it difficult to parse out whether treatment optimism was the primary driver of these changes.

Indeed, during this period, Internet-mediated technologies (i.e., apps and websites) have also emerged as an important social and sex seeking venues for GBM and researchers have demonstrated that apps and websites have had a profound impact on GBM communities (Grov, Breslow, et al., 2014). Comparisons between online and offline samples and other approaches assessing Internet use among GBM show that online samples are younger (Allman, Meyers, Xu, & Steele, 2012), less likely to identify as gay (Grov, Rendina, et al., 2014), and exhibit lower community attachment and social embeddedness (Fernández et al., 2007; Grov, 2011; Grov, Rendina, et al., 2014; D. McKirnan et al., 2007), suggesting important differences between GBM connected online and those who are not. Further, online sex seeking has been associated with having more sexual partners (Abara, Annang, Spencer, Fairchild, & Billings, 2014; Broaddus et al., 2015; Hernandez-Romieu et al., 2014; Phillips et al., 2014; White et al., 2013), differing patterns of HIV risk management (Berry et al., 2008a; Holloway et al., 2014; S. W. B. Noor, Rampalli, & Rosser, 2014b), and higher odds of condomless anal sex (Lewnard & Berrang-Ford, 2014; Liau et al., 2006; Yang et al., 2014b). With the arrival of

sex seeking apps in 2009, these trends continue to merit significant attention from health researchers (Grosskopf, LeVasseur, & Glaser, 2014; Hull et al., 2016; Tang et al., 2016).

However, some of the differences between Internet and non-Internet users simply arise from the ways that the use of Internet-mediated technologies has been operationalized. For example, Jenness et al. found that, on average, men who meet partners both online and offline had significantly more partners than men who reported meeting partners only online or only offline (Jenness et al., 2010). Further, these studies have generally shown that GBM who meet partners both online and offline are the most likely to engage in condomless anal sex (CAS; Horvath et al., 2008; Hull et al., 2016; Kerr, Pollack, Woods, Blair, & Binson, 2014; Leung, Poon, & Lee, 2014; Noor et al., 2014a, p. 201; Wei et al., 2014). Similarly, Grov et al. reported that men who preferred meeting partners online had significantly more partners than men who preferred meeting partners at bars, but not more than those who preferred meeting partners at bathhouses—highlighting heterogeneity linked to venue preference (Grov, 2011). Similar associations have also been documented when exploring so called “scenes” as “micro-cultures” (Noor et al., 2017). With respect to these scenes, I also note that not all Internet-mediated locales are the same: not only can distinctions be drawn between websites and apps, but even within these two domains there is a significant amount of variation (Grosskopf et al., 2014; Tang et al., 2016).

Despite these observations, it is unlikely that the observed differences between online and offline groups can be attributed to methodology alone. Information systems researchers studying the uptake of new technologies argue that they diffuse in predictable patterns, based on specific user characteristics (e.g., age, social attitudes, etc.). For example, technology acceptance models (Venkatesh, Morris, Davis, & Davis, 2003) posit that four key constructs predict technology uptake: (i) performance expectancy, (ii) effort expectancy, (iii) social influence, and (iv) facilitating conditions. Similarly, the Reasoned Action Approach (Fishbein & Ajzen, 2011), applied to sexuality, suggests that sexual behaviour can be predicted by one’s (i) behavioural beliefs, (ii) normative beliefs, (iii) control beliefs, and (iv) actual controls over one’s behaviour. Together, these behavioural models highlight the central role of cognitive dispositions in shaping human agency. However, they also raise an important question: How do these dispositions come to be?

In the canons of risk theory, rational choice models emphasize the central importance of beliefs, but they do not speak well to how and why individuals come to believe the things they do (Douglas, 2003). Addressing this limitation, sociocultural theory can be used to help us understand the social genesis of personally held beliefs and worldviews and thereby explain better why people do the things they do (Ordóñez & Marconi, 2012). Sociocultural theory therefore seeks to liberate individuals from psychological flowcharts and conceptualize them instead as social animals embedded within social environments. In other words, sociocultural theory expands the discourse about risk into examinations of social interactions, relationships, and situations (Lippman et al., 2014), thereby reorienting academic inquiry towards not just one's objective knowledge about risk, but also their cultural interpretations of these risks.

Among many potentially relevant constructs evaluated in the social sciences, the tensions between individualism (i.e., self-determination, reliance, and definition) and collectivism (i.e. group-structured determination, reliance, and definition) has garnered widespread attention since its use by Hofstede to describe national cultural dimensions (Hofstede, 2011; Slovic, 1999)—though they were considered earlier by others (Douglas & Calvez, 1990). In person-level analyses, collectivism and individualism are perceived as two dimensions of a related construct, with individuals within strongly bound social groups having stronger collectivism and loosely networked groups possessing stronger individualism. Examining the relationship between collectivism and technology, collectivism has been associated with slower uptake of new technologies (Lim, Leung, Sia, & Lee, 2004; Lunjun, 2003) and a tendency to only embrace technology on the proviso that it is compatible with group norms (Abbasi, Tarhini, Elyas, & Shah, 2015). Dake further distinguishes between egalitarian and hierarchical collectivists (Dake, 1991), suggesting that egalitarian collectivists tend to perceive new technologies as threats to their social structure (Markus, 1994; Straub, Keil, & Brenner, 1997), while hierarchical collectivists are more likely to perceive them as tools by which they can expand their social dominance (Dake, 1991).

In a similar fashion, culture also appears to shape sexual behaviour. For example, Lo et al. found that collectivism was associated with maintenance of sexual norms, while individualism was associated with more liberal beliefs regarding sexual behaviour (Lo, So, & Zhang, 2010a). Similarly, collectivism has also been shown to impact the level of stigma that sexual minorities feel, with higher collectivism contributing to higher stigma

when an individual is in violation of group norms (Liu et al., 2011). Another, related concept known as sexual altruism (i.e., prioritization of collective-interest over self-interest) has also been shown to predict GBM's sexual behaviour (Nimmons, 1998; Nimmons & Folkman, 1999; O'Dell et al., 2008). Complicating this picture, Douglas and Calvez (Douglas & Calvez, 1990) insist that the group norms of egalitarian collectivists are usually grounded in community experience, while those of hierarchical collectivists usually rely on established authorities. Therefore, altruistic and collectivistic motivations may take on very different forms, depending on the ways groups respond to one another and to scientific authority, thereby highlighting the influence of cultural collectivism on the formation of subjective-risk perceptions.

Among GBM, community and culture have long been reflected in the ways they connect with one another (both socially and sexually). Beginning in the 1960's, gay men began to organize themselves in neighborhoods where they could find a greater sense of safety and security (Meyer, 1995). As such, gay neighborhoods, complete with gay bars, clubs, bookstores, publications, and many other amenities, have become a common feature of major urban centers (B. C. Kelly et al., 2012). However, the Internet and other socio-economic forces have attracted GBM to other neighborhoods (Ghaziani, 2014), decreasing the centrality of these in-person venues in the lives of GBM (Holt, 2011). Further, theories of social behaviour suggest that individuals seek out forms of social participation that are consistent with their social and cultural values (B. Schneider, 1987; B. Schneider, Brent, & Goldstein, 2000)—creating so called 'micro-cultures,' or what are colloquially referred to as 'scenes' (Noor et al., 2017).

Together, the evidence and theory summarized above suggest that patterns of community connectedness may reflect, to some degree, the underlying cultural values of gay men, and thus may also play a role in shaping their sexual behaviour – perhaps in terms of power, as Foucault likes to think, or in terms of social learning, as Bandura suggests, or by any number of theorists who have before written on these subjects (Bandura, 1986; Foucault, 1984). However, there is limited research exploring the role of collectivism in the context of GBM's health and HIV prevention. Therefore, the present analysis explores patterns of online and offline connectedness among GBM and examines their relationship to GBM's prevention-related beliefs and behaviour.

3.3. Methods

3.3.1. Study Protocol

Baseline cross-sectional data were analyzed from participants enrolled in the Momentum Health Study, a longitudinal prospective cohort based in Metro Vancouver, Canada. In brief, participants were recruited if they met the following eligibility criteria: (i) identified as a man, (ii) reported sex with another man in the past six months, (iii) were 16 years of age or older, (iv) could complete a questionnaire in English, and (v) were recruited using respondent-driven sampling (RDS) between February 2012 and February 2015. Initially, 30 seeds were selected and given six coupons each. However, due to under-productive chain sampling, additional online and offline-recruited seeds (n = 89) were added throughout the recruitment process to achieve equilibrium across key indicators. Each eligible participant recruited by RDS-seeds received six vouchers, which they were encouraged to give to other eligible participants. Additional information regarding formative research and RDS-sampling procedures for this study are provided elsewhere (Forrest et al., 2014, 2016; Lachowsky, Lal, et al., 2016; Moore et al., 2016). Upon receipt of informed consent, bio-behavioural and psychosocial data were collected using a computer-administered questionnaire. After completion of the questionnaire, a study nurse administered a point-of-care HIV test to HIV-negative individuals and viral-load and CD4+ cell count tests for HIV-positive individuals. Serological screens for hepatitis C and syphilis were also performed; screenings for gonorrhea and chlamydia were optional. Participants were reimbursed an honorarium of $50 CAD at each study visit and $10 CAD for each participant they recruited into the study. Additional details regarding study protocol are reported elsewhere (Moore et al., 2016). Ethics approval for this study was granted by the Research Ethics Boards at Simon Fraser University, the University of British Columbia, and the University of Victoria.

3.3.2. Dependent Variable

Recognizing that simple dichotomies of connectedness, such as “online versus offline,” are unlikely to provide sufficient insight into understanding the relationship between GBM’s social and sexual behaviour, the present study explored patterns of connectedness using a person-centered analytic approach known as “latent class analysis” (LCA; Collins & Lanza, 2013)). This approach is a sub-type of structural

equation modelling that leverages measured variables, or indicators, to identify unmeasured latent constructs. In this way, it is similar to factor analysis, but instead of exporting a continuous latent variable, LCA constructs are categorical. These LCA categories are referred to as “classes” and emphasize differences in quality, not just quantity. For this reason, LCA has been lauded as a potentially useful analytic strategy for describing social and behavioural phenomena (Collins & Lanza, 2013).

3.3.3. Independent Variables

Independent variables included participant demographics, prevention-related behaviour, Treatment as Prevention (TasP) awareness, sexual altruism, collectivism, and perceptions of treatment optimism and HIV/AIDS stigma. Demographic measures included age, sexual orientation (gay vs. other), disclosure of sexual orientation (out, coming out, non-gay identified [including bisexual]), race (white, Indigenous, other), annual income in Canadian dollars (<$30,000, ≥$30,000), geographic residence (downtown Vancouver, elsewhere in Vancouver, outside Vancouver) and the participant’s self-reported HIV-status (negative, positive, unknown). HIV/STI testing was assessed by whether they had ever (yes versus no) or recently been tested for HIV (Recently = Past 24 months; yes versus no) and recently tested for other STIs (past six months [P6M], yes versus no). Questions regarding sexual behaviour assessed the participant’s relationship status (monogamous/married, open/partially open relationship, no regular partner), how many male sex partners they had in the past six months, and whether they engaged in CAS with a serodiscordant or unknown status partner in the past six months (yes versus no). Seroadaptive strategies were assessed by asking HIV-positive and HIV-negative men whether they engaged in any of the following strategies: consistent condom use (yes versus no), strategic positioning for CAS (yes versus no), anal sex avoidance (yes versus no), serosorting for CAS (yes versus no), viral load sorting for CAS (yes versus no), withdrawal for CAS (yes versus no), or always asking partners their HIV status (yes versus no; Card, Lachowsky, Cui, Carter, et al., 2016). These questions were assessed using different wording for HIV-positive and HIV-negative men (e.g., to assess strategic positioning HIV-positive men were asked if they bottomed for CAS to avoid transmission and HIV-negative men were asked if they topped for CAS to avoid HIV-acquisition). Questions regarding TasP assessed whether they had ever heard of TasP (yes versus no) and whether they learned about TasP from

any of the following sources: their sex partners (yes versus no), a community agency (yes versus no), their doctor or another healthcare professional (yes versus no), gay news/media (yes versus no), or other media (yes versus no). Consent to data linkage with the British Columbia Centre for Excellence in HIV/AIDS's Drug Treatment Program was used to determine viral load (<50 copies/ml, 51 – 200 copies/ml, >200 copies/ml) and CD4 cell counts (≥500 cells/μL, 200 – 499 cells/μL, <200 cells/μL) of HIV-positive participants, whether they were currently on treatment (yes versus no), and if they were adherent to HAART (pharmacy refill, ≤ 95% vs. >95%; (Grossberg & Gross, 2007). Finally, treatment optimism, HIV/AIDS stigma, altruism, and collectivism were assessed using four scales:

The Treatment Optimism-Skepticism scale (study α = 0.82) was used to assess GBM's risk perceptions regarding HIV in the HAART era. Response scores, ranging from 0 – 36, were summed across 12 items (e.g., "HIV is less of a threat because the epidemic is on the decline.") with Likert-based response options (i.e., strongly disagree, disagree, agree, strongly agree), with higher scores representing higher treatment optimism (Van de Ven et al., 2000).

The HIV/AIDS Stigma Scale (study α = 0.81) allowed respondents to rate their level of agreement. using a four-point Likert scale (i.e., strongly disagree, disagree, agree, strongly agree), with six items assessing perceptions of HIV/AIDS stigma in GBM communities (e.g., "HIV-negative men treat a guy differently when they know he is HIV-positive"). Scores ranged from 6 – 24 with higher scores indicating higher perceived stigma (Courtenay-Quirk, Wolitski, Parsons, Gómez, & Seropositive Urban Men's Study Team, 2006).

The Sexual Altruism scale is comprised of two subscales which assessed personal altruism (study α = 0.82; 7 items; e.g., "Having safer sex shows I care about my partner"; "I have a responsibility to stop my partner from doing something risky") and communal altruism (study α = 0.88; 6 items; e.g., "Having safer sex is what gay men should do for each other"; "I have safer sex because I want the gay community to survive"). Each subscale was scored separately by dividing the summed Likert response item scores (i.e., disagree strongly, disagree somewhat, neither agree or disagree, agree somewhat, agree strongly) by the number of questions answered. Scores ranged from 0 – 4, with higher scores representing higher altruistic motivations for safer sex (O'Dell et al., 2008).

A scale measuring collectivist attitudes towards the GBM community (herein referred to as collectivism; study $\alpha = 0.81$, range = 0 – 12) was created from four items: (i) “Being part of the gay/bisexual/queer community is an important reflection of who I am;” (ii) “Belonging to the gay/bisexual/queer community is not a good thing for me (reverse scored);” (iii) “Being part of the gay/bisexual/queer community has a lot to do with how I feel about myself;” and (iv) “How important is it to you to be connected to and involved in the GBM community?”. Items 1 through 3 were scored on a four-point Likert scale measuring agreement (i.e., strongly disagree, disagree, agree, strongly agree) and item 4 was scored on a four-point Likert scale measuring importance (i.e., not at all important, not very important, somewhat important, very important). Total scores ranged from 0 to 12, with higher scores representing higher collectivism. I acknowledge that although this scale might not measure a general sense of psychological collectivism, reviews have repeatedly highlighted the problem of operationalizing cultural values on an individual level and one review suggests that quantitative indices “need to be tailored for the social contexts under examination” (Tansey & O’riordan, 1999, p. 83). As such, this is the approach that was taken in constructing the present scale.

3.3.4. Data Analysis

In the present analysis, nine indicator variables were modeled using the PROC LCA procedure in SAS v.9.4. These variables assessed whether participants read gay news/media (P6M, yes versus no), participated in gay group meetings (P6M, yes versus no), patronized gay bars and clubs (P6M, yes versus no), played on gay sports teams (P6M, yes versus no), attended the most recent gay pride parade (yes versus no), spent more than 50% of their social time with other GBM ($\geq$50% versus <50%), had a Facebook page (yes versus no), used websites to seek sex (P6M, yes versus no), and used apps to seek sex (P6M, yes versus no).

LCA model selection was made with consideration to statistical fit of the models (i.e., AIC, BIC, CAIC, aBIC) and the interpretability and differentiation of LCA classes (See Figure 7). The two-class, three-class, and four-class models each had high conceptual interpretability and distinguishability. AIC was minimized in the six-class model, although BIC, CAIC, and aBIC were minimized in the three-class LCA model. Therefore, the three-class solution was selected (See Figure 8). Each participant was then probabilistically assigned to an LCA class based on the vector of classification

probabilities generated for each participant based on their observed item-responses. Due to the selected analytic approach, statistics were not adjusted using RDS weights.

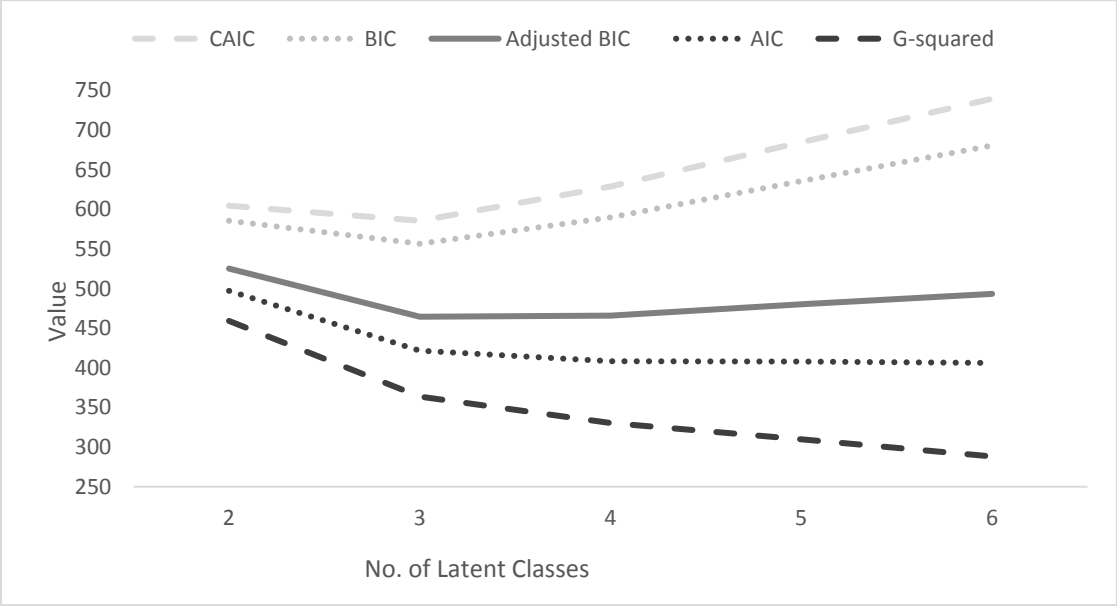

Figure 7. Fit Statistics Considered in the Selection of LCA Models

Using the PROC LOGISTIC procedure, univariable and multivariable multinomial logistic regression models were then used to identify the relationship between dependent and independent factors. Three pairwise comparisons were conducted: Class 1 versus Class 2, Class 1 versus Class 3, and Class 2 versus Class 3. Models were specified using a backwards selection method, wherein variables with a bivariate p-value greater than 0.20 were initially included. Variables with the lowest Type-III p-value at each step were then omitted in a step-wise fashion until the model fit statistic (i.e., AIC) was minimized. Bivariate p-values and multivariable adjusted odds ratios (AOR) with 95% confidence intervals are reported. Given the relatively open time-frame for sampling using RDS, multivariable models were adjusted for time of recruitment.

3.4. Results

A total of 774 GBM were recruited. The median age of this sample was 34 years (Q_1, Q_3: 26, 47). Most participants were HIV-negative men (n =551, 71.2%), white (n = 585, 75.6%), single (n = 477, 61.6%), had annual incomes of < $30,000 CAD (n = 485, 62.7%), identified as gay (n = 655, 84.6 %), and were “out” (n = 611 78.9%). The plurality of men lived in downtown Vancouver (n = 382, 49.4%) or elsewhere in the city

(n = 240, 31.0%). The sample reported high levels of connectedness: 82.7% (n = 640) read gay news media, 82.6% (n = 639) had a Facebook account; 79.7% (n = 617) patronized gay bars or clubs, 62.8% (n = 486) attended the most recent gay pride parade, 63.1% (n = 488) sought sex on websites, 54.4% (n = 421) sought sex on apps, 50.3% (n = 389) spent more than half of their social time with other GBM, 38.8% (n = 300) attended gay group meetings, and 11.6% (n = 90) played on gay sports teams.

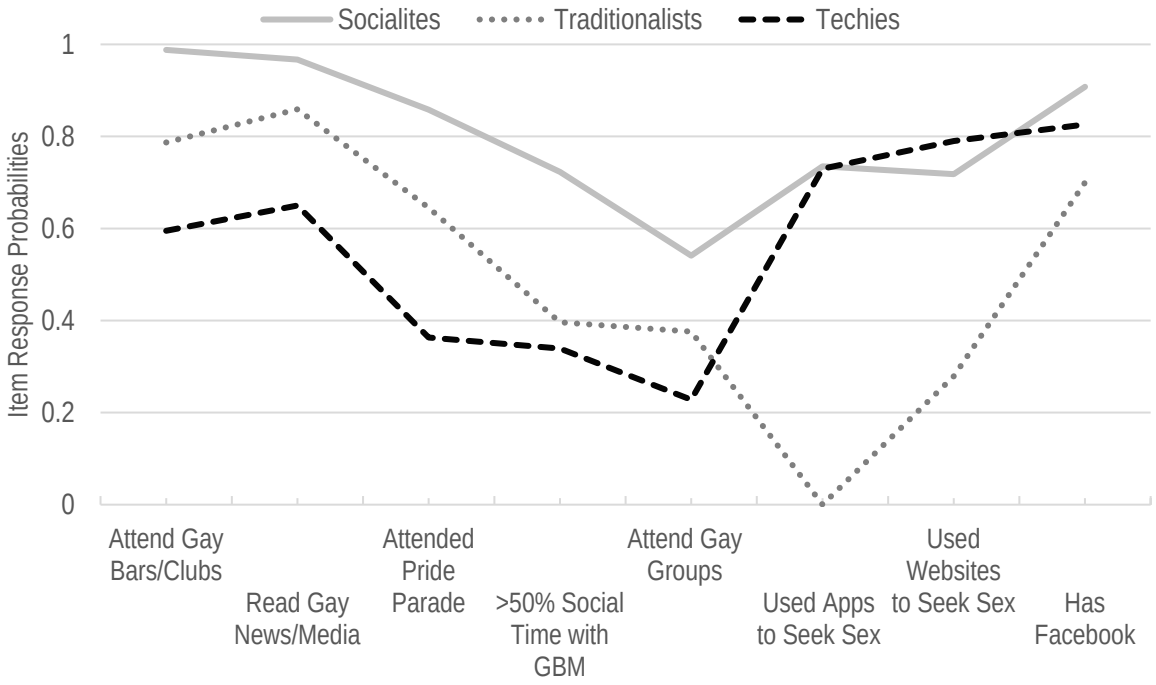

Figure 8. Latent Patterns of Online and Offline Community Connectedness

Table 2 provides an overview of the selected LCA model, showing the response item probabilities for each latent class. In summary, the first latent class, described herein as "Socialites", due to relatively high in-person and Internet-based connectedness, made up 38.8% of the sample. Approximately one-quarter (25.8%) of the sample was assigned to the second latent class, known as "Traditionalists." This group was characterized by moderately high in-person connectedness and low Internet-based connectedness. The third latent class, which comprised 35.4% of the sample, is described as "Techies", due to lower in-person connectedness but high online connectedness.

Table 2. Latent Patterns of Community Connectedness

Latent Class	1		2		3	
Assigned Label	Socialites		Traditionalists		Techies	
	n	%	n	%	n	%
Distribution of Class Membership	300	38.8	199	25.8	274	35.4
Indicators						
Attend Gay Bars/Clubs in P6M	297	98.8	157	78.7	163	59.5
Read Gay News/Media in P6M	290	96.7	171	85.9	178	65.0
Attended Gay Pride Parade in P12M	258	85.8	129	64.5	100	36.3
>50% Social Time Spent with GBM	217	72.3	79	39.6	93	33.9
Attend Gay-Specific Groups in P6M	162	54.1	75	37.6	63	22.8
Currently Has a Facebook Page	273	90.8	140	70.0	227	82.6
Use Websites to Seek Sex in P6M	216	71.8	56	27.9	217	79.0
Use Apps to Seek Sex in P6M	221	73.5	0	0.0	200	73.0

Note: P6M = Past 6 Months; P12M = Past Year

Figure 9 illustrates recruitment of the sample across time, grouped by LCA class. The median date of recruitment for "Socialites," "Traditionalists" and "Techies," were respectively: April 9th, 2013 (Q_1, Q_3: Sept. 19th, 2012 – Sept. 11th, 2013), Apr. 25th, 2013 (Q_1, Q_3: Oct. 23rd, 2012 – Sept. 7th, 2013), and May 21st, 2013 (Q_1, Q_3: Jan. 8th, 2013 – Oct. 8th, 2013). These data suggest that "Techies" were on average, recruited later than "Socialites" ($p = 0.011$) and "Traditionalists" ($p = 0.002$). There was no significant difference between "Traditionalists" and "Socialites" ($p = 0.145$).

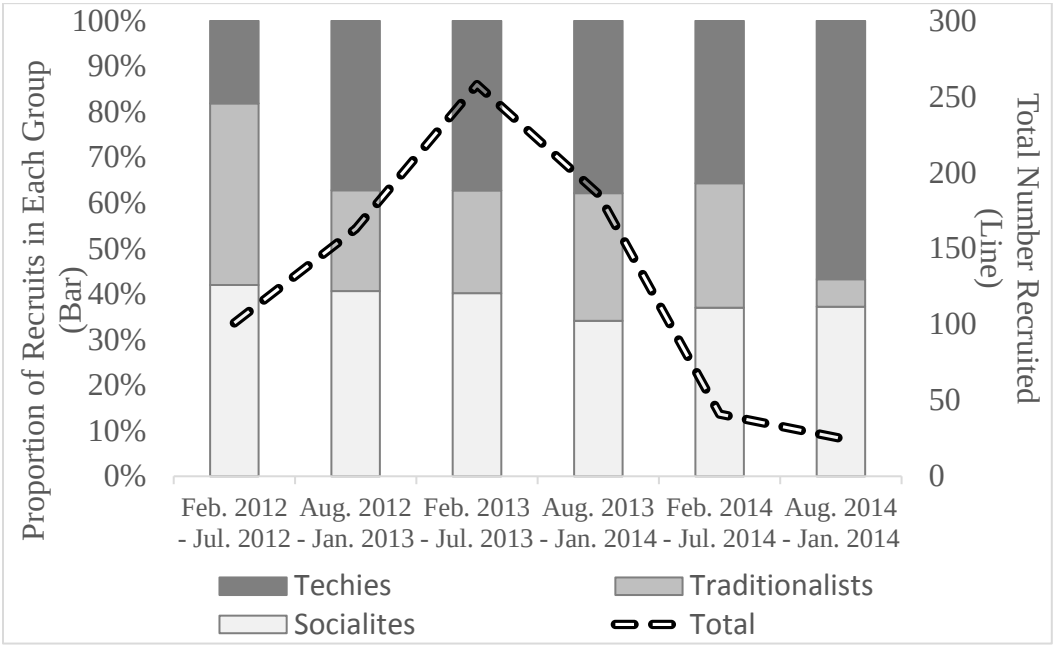

Figure 9. Temporal Recruitment of Participants by Latent Class

Table 3 provides the univariable demographic and social covariates of LCA class membership. Of note, Socialites had higher collectivism scores, higher annual incomes, and were more likely to identify as gay compared to men in the other two classes. Compared with Socialites, Traditionalists were more likely to be older, Indigenous, married or monogamous, and perceived lower HIV/AIDS stigma in the GBM community, while Techies were more likely to be coming out and report lower communal and personal sexual altruism scores. On average, compared with Traditionalists, Techies tended to report lower collectivism, were younger, less likely to be white, and less likely to live in downtown Vancouver (vs. elsewhere in Vancouver). However, Techies were more likely to be single, closeted, and have higher HIV/AIDS stigma scores.

Table 4 provides the univariable health-related covariates of LCA class membership. Traditionalists were less likely than Socialites to have always used condoms, always asked their partner's HIV status prior to sex, and recently been tested for HIV, recently been tested for other STIs, ever been tested for HIV, and ever been tested for other STIs. Further, they had fewer sexual partners and were more likely to self-identify as HIV-positive or to not know their HIV status. Techies were less likely than Socialites to have heard of TasP, particularly from a community agency. Comparing Techies with Traditionalists, Techies were more likely to have had a recent STI test, have had a recent HIV test, been HIV-negative, have asked their partner's HIV status consistently, have had engaged in any recent serodiscordant or unknown CAS, and had more sexual partners in the past six months. Across all three groups, there were no significant differences in whether they heard about TasP from sex partners, health professionals, or the media, nor were their significant differences in strategic positioning (i.e. anal sex avoidance, serosorting, viral load sorting, withdrawal). For HIV-positive men, there were no significant differences in treatment status, treatment adherence, viral load, and CD4 counts.

Table 5 provides the multivariable adjusted models identifying the independent covariates of class membership. In this model, Techies were significantly more likely to be recruited later than Socialites and Traditionalists, though no difference was observed between Socialites and Traditionalists. Further, Socialites were more likely than Traditionalists and Techies to have higher collectivism scores and an annual income >$30,000. Compared with Socialites, Traditionalists were older, less likely to be single, had lower HIV/AIDS stigma scores, had fewer sexual partners, and were less likely to

have ever tested for HIV. Comparing Techies and Traditionalists, Techies had lower collectivism and were younger, and they were more likely to be single, to have ever been tested for HIV, to ask their partner's HIV status, to engage in CAS with a serodiscordant or unknown status partner, and to have more sexual partners in the past six months.

Table 3. Demographic and Social Characteristics of Latent Classes

	Class 1: Socialites	Class 2: Traditionalists	Class 3: Techies	Bivariate Comparisons		
				1 vs. 2	1 vs. 3	2 vs. 3
	%	%	%	p	p	p
Age	31 (25,44)	43 (30,50)	32 (26,44)	<.0001	0.588	<.0001
Race						
White	77.9	76.6	72.3	Ref	Ref	Ref
Indigenous	3.7	10.3	6.8	0.007	0.079	0.283
Other	18.4	13.1	21.0	0.212	0.338	0.043
Annual Income						
<$30,000	54.7	70.8	65.4	Ref	Ref	Ref
≥30,000	45.3	29.2	34.6	0.000	0.009	0.220
Current Relationship						
Monogamous/Married	15.1	24.5	12.0	Ref	Ref	Ref
(Partially) Open	23.6	24.0	18.8	0.094	0.991	0.125
No Regular Partner	61.4	51.6	69.2	0.006	0.168	<.0001
Non-Gay Identified (vs. Gay)	12.6	19.8	15.3	0.030	0.351	0.199
Being Out						
Yes, I am "out"	84.6	76.4	74.6	Ref	Ref	Ref
No/I'm still "coming out"	7.9	6.0	13.3	0.640	0.020	0.019
Not Gay, Bi-, Queer identified	7.5	17.6	12.2	0.001	0.035	0.193
Neighborhood						
Downtown/West End	50.0	55.8	44.0	Ref	Ref	Ref
Elsewhere Vancouver	32.1	25.4	33.9	0.106	0.344	0.016
Outside Vancouver	17.9	18.8	22.2	0.798	0.128	0.101
HIV/AIDS Stigma Scale	18 (17, 20)	18 (16, 19)	18 (17, 20)	0.002	0.924	0.002
Communal Altruism Scale						
Low – 0.0-2.9	25.1	27.6	33.3	Ref	Ref	Ref
Moderate – 3.0-3.7	36.1	30.4	33.2	0.272	0.087	0.680
High – 3.8-4.0	38.9	42.0	33.6	0.944	0.043	0.074
Personal Altruism Scale						
Low – 0.8-3.0	25.7	30.6	93	Ref	Ref	Ref
Moderate – 3.1-3.6	33.8	26.2	73	0.079	0.018	0.716
High – 3.7-4.0	40.5	43.2	101	0.629	0.071	0.237
Collectivism						
Low	9.7	19.9	30.3	Ref	Ref	Ref
Moderate	20.5	24.8	28.1	0.094	0.003	0.259
High	19.5	18.2	16.8	0.015	<.0001	0.089
Very High	50.3	37.2	24.7	0.000	<.0001	0.001

Italics indicate reporting of *median and* Q_1, Q_3 for continuous variables; Pairwise comparisons were tested using bivariate multinomial logistic regression at $p < 0.05$; OR = Odds Ratio; CI = Confidence Interval; PM = Past Month

Table 4. Health-Related Characteristics of Latent Classes

	Class 1:	Class 2:	Class 3:	Bivariate Comparisons		
	Socialites	Traditionalists	Techies	1 vs. 2	1 vs. 2	1 vs. 2
	%	%	%	*p*	*p*	*p*
Heard of TasP *(mutually exclusive)*	55.5	52.9	46.3	0.568	0.029	0.160
…from Sex Partner(s)	18.7	10.2	14.5	0.096	0.407	0.383
…from Community Agency	43.7	32.5	28.4	0.101	0.019	0.542
…from Health Professional	26.8	29.3	22.9	0.698	0.505	0.333
…from Gay Media	39.7	32.5	32.7	0.285	0.277	0.983
…from Other Media	21.9	20.4	21.8	0.787	0.984	0.814
Any STI-Tested, ever	94.8	88.4	92.0	0.011	0.182	0.190
Any STI-Tested, P6M	61.1	49.5	63.5	0.017	0.580	0.005
HIV-Tested, ever	95.5	90.6	95.7	0.032	0.935	0.031
HIV-Tested, P2Y	68.4	44.8	63.9	<.0001	0.250	<.0001
Self-reported HIV Result						
Negative	70.2	51.6	65.1	Ref	Ref	Ref
Positive	22.1	37.2	28.2	<.0001	0.102	0.013
Unknown	7.7	11.2	6.7	0.034	0.845	0.028
Currently on Treatment *(HIV+ Only)*	81.1	87.5	77.7	0.291	0.620	0.117
> 95% Adherence P12M (vs. ≤ 95%)	62.1	58.9	48.0	0.693	0.087	0.177
Viral Load						
<50 copies/mL	72.7	68.6	70.8	Ref	Ref	Ref
51 – 200 copies/mL	16.0	11.2	10.3	0.557	0.420	0.831
>200 copies/mL	11.4	20.2	18.9	0.193	0.271	0.818
CD4						
≥500 cells/μL	66.3	52.9	62.1	Ref	Ref	Ref
200-499 cells/μL	29.7	39.1	31.0	0.166	0.768	0.263
<200 cells/μL	4.0	8.0	7.0	0.226	0.422	0.634
HIV Risk Management *(mutually exclusive)*						
Always Uses Condoms	60.5	51.0	52.8	0.036	0.062	0.705
Strategic Positioning	31.1	25.8	29.7	0.207	0.714	0.360
Anal Sex Avoidance	50.2	41.2	44.1	0.052	0.145	0.541
Serosorting for Condomless	41.6	36.6	40.7	0.274	0.844	0.368
Viral-load Sorting	18.5	16.6	19.0	0.592	0.886	0.514
Withdrawal	31.1	26.4	27.1	0.264	0.294	0.872
Ask Partners their HIV Status	62.3	45.6	63.9	0.000	0.685	<.0001
Any Serodiscordant or Unknown CAS, P6M	38.1	29.5	45.6	0.050	0.073	0.001
# Male Sex Partners, P6M: *median (Q1, Q3)*	*6 (3,15)*	*3 (1,7)*	*6 (3,15)*	0.009	0.301	0.007

Italics indicate reporting of *median and* Q_1, Q_3 for continuous variables; Pairwise comparisons were tested using bivariate multinomial logistic regression at $p < 0.05$; OR = Odds Ratio; CI = Confidence Interval; P6M = Past 6 Months; P12M = Past 12 Months; P2Y = Past 2 Years

Table 5. Covariates of Latent Class Membership

	Traditionalists vs. Socialites	Techies vs. Socialites	Techies vs. Traditionalists
	aOR (95%CI)	aOR (95%CI)	
Age (per year older)	1.06 (1.04-1.07)	1.01 (1.00-1.03)	0.96 (0.94-0.98)
Annual Income (≥30,000 vs. <$30,000)	0.42 (0.28-0.65)	0.60 (0.42-0.87)	1.42 (0.92-2.20)
Current Relationship			
Monogamous/Married	Ref	Ref	Ref
(Partially) Open	0.68 (0.37-1.23)	1.09 (0.59-2.02)	1.62 (0.85-3.07)
No Regular Partner	0.55 (0.32-0.93)	1.42 (0.83-2.41)	2.59 (1.48-4.51)
Collectivism	0.82 (0.75-0.89)	0.75 (0.69-0.81)	0.92 (0.84-0.99)
Stigma Scale	0.93 (0.87-0.99)	0.99 (0.93-1.06)	1.07 (1.00-1.15)
HIV Tested, Ever	0.38 (0.17-0.86)	1.18 (0.50-2.78)	3.11 (1.36-7.15)
Ask Partners their HIV Status	0.59 (0.40-0.87)	0.99 (0.69-1.43)	1.69 (1.13-2.52)
Any sdCAS, P6M	0.74 (0.48-1.14)	1.36 (0.94-1.97)	1.85 (1.20-2.85)
# Male Sex Partners, P6M	0.99 (0.98-1.00)	1.00 (1.00-1.00)	1.01 (1.00-1.02)

CBO = Community Based Organization; sdCAS = Serodiscordant/Unknown Condomless Anal Sex; P2Y = Past 2 Years; P6M = Past 6 Months; aOR = Adjusted Odds Ratio; CI = Confidence Interval

3.5. Discussion

3.5.1. Primary Findings

This chapter seeks to examine how collectivist attitudes (i.e., collectivism, altruism), risk perceptions (e.g., HAART optimism, HIV/AIDS stigma, TasP awareness), and behaviour (i.e., HIV/STI-testing history, prevention strategies, serosorting) loaded onto nuanced patterns of social and community connectedness among GBM. In doing so, latent class analysis was used to characterize GBM's patterns of online and offline attachment to the their communities. The results of this analysis highlight diversity in the ways GBM connect to their communities. Differences in group participation primarily arose from the intensity of their connectedness and from their uptake of socio-sexual networking apps and websites.

Further, class membership was strongly associated with age-cohort effects (i.e., age), socioeconomic status, sexual attitudes and behaviours, altruistically motivated sexual behaviour, and collectivism among GBM. Class membership was also associated with time of recruitment, with Techies being more likely to be recruited later in the study. This is consistent with technology-acceptance models that have shown that technology uptake is a culturally embedded process (Abbasi et al., 2015; Dake, 1991; Straub et al., 1997; Venkatesh et al., 2003) — highly correlated with age-cohort effects, social

attitudes towards technology uptake, and the diffusion processes of these technologies themselves. Similar patterns of culturally dependent diffusion have been documented with respect to the emergence of email (Lunjun, 2003) and online shopping (Frost, Goode, & Hart, 2010; Lim et al., 2004).

Of course, patterns of connectedness (as operationalized in the present analysis) are predicted by more than just cultural dispositions. I observed that class membership was also associated with practical motivators, evidenced by person-level characteristics. For example, compared with Socialites, Traditionalists were more likely to be older (suggesting an age-cohort effect), to be in a relationship, and to have fewer partners. Similarly, Socialites had higher annual incomes than both Traditionalists and Techies, and Techies were younger, had more sexual partners, and were more likely to be single than Traditionalists. These associations highlight the practical implications of community connectedness. For example, the associations between class membership and income likely reflects the importance of disposable time and resources — with more affluent gay men being able to afford greater connectedness (Barrett & Pollack, 2005). Similarly, the association between relationship status and class membership is likely reflective of the impact that having a regular partner has on one's motivations for online sex seeking. Further, the association between online sex seeking and partner number highlights an important function of apps and websites—namely that they allow GBM to find more sexual partners. Together these factors highlight the diverse drivers that underlie the ways GBM connect with their communities (Miller, 2015; Michael W. Ross, Rosser, McCurdy, & Feldman, 2007b).

3.5.2. Implications

Connecting these patterns of connectedness and their relationship with HIV risk management, the findings of the present analysis offer several relevant implications. For example, univariable and multivariable comparison of Socialites and Traditionalists point to a greater tolerance of HIV risk among Traditionalists. For example, on the univariable level, Traditionalists (vs. Socialites) had lower HIV/AIDS stigma, were more likely to be HIV-positive or not know their HIV status, and were less likely to have had an HIV/STI test, use condoms consistently, or ask their partner's HIV status prior to sex. On the multivariable level, lifetime lack of HIV testing and decreased likelihood of inquiry of partner serostatus persisted even after accounting for other factors. This limited HIV

aversion among Traditionalists might be the result of social norms within these networks that are more inclusive of people living with HIV (Burnham et al., 2016). Alternatively, these findings may highlight the role of the Internet in promoting HIV stigma among GBM (Smit et al., 2012). For example, because the Internet better facilitates the disclosure of individual's HIV status, HIV-positive Internet users may experience more frequent sero-discrimination from potential partners who use serosorting strategies to prevent HIV acquisition (Berry et al., 2008a; Smit et al., 2012).

However, comparing the behaviour of Techies and Traditionalists, these findings also suggest that Techies may be more willing to engage in higher risk behaviours (i.e. serosorting for CAS, more sexual partners). Considering this within the context of lower collectivism scores, I note that previous research has shown that individualism has been associated with both the uptake of the Internet (Abbasi et al., 2015; Lee & Choi, 2005; Lunjun, 2003) and more adventurous sexual norms (Douglas & Calvez, 1990; Lo et al., 2010a). With that said, Techies were also more likely than Traditionalists to have ever tested for HIV and to ask their partner's HIV status before sex—suggesting increased willingness to engage in HIV-prevention strategies which strike a better balance between risk and pleasure. Again, previous research has shown that greater individualism is associated with the uptake of novel risk-prevention strategies (Douglas & Calvez, 1990). These observed interrelationships between collectivism, connectedness, and risk behaviour may lend indirect support to (Douglas & Calvez, 1990) cultural theory of HIV risk among GBM, which aims to describe the role of social and cultural factors in shaping risk perceptions and behaviour among GBM (Dake, 1991; Peters & Slovic, 1996). However, these findings suggest that the patterns of community connectedness I have measured here are more strongly indicative of HIV attitudes (HIV/AIDS Stigma), health service uptake (i.e., HIV/STI testing), and, potentially, high-risk sexual behaviour (i.e., CAS with serodiscordant or unknown status partners); and less indicative of patterns of sexual behaviours (i.e., seroadaptation). In fact, apart from a few key behaviours (i.e., serodiscordant sex, number of partners), sexual behaviour did not vary according to patterns of social connectedness—at least as operationalized in the present study. This may suggest that sexual practices in GBM communities are amenable to a variety of cultural orientations (i.e., the socially constructed inclinations of individuals towards specific ways of thought, behaviour, or emotion) or modes of community participation.

In light of research by Rodger et al., (2016), which suggests that a person with a suppressed viral load is unlikely to pass on HIV to their sexual partners, GBM now have a variety of community-grounded and scientifically-supported options for HIV prevention (Otis et al., 2016); it appears that these options have diffused across the patterns of online and offline connectedness examined in the present study. Consistent with these findings, health promotion efforts, specifically those targeting HIV attitudes and health-service uptake, may need to better account for the influence that cultural and social factors have in shaping the diffusion and uptake of these efforts. Of course, further research is needed to explicitly examine how collectivism and other cultural orientations might specifically influence prevention-related beliefs and behaviours. This is particularly important for emerging prevention strategies when their uptake is dependent on GBM's attitudes towards them, such as may be the case with pre-exposure prophylaxis (PrEP). Future studies should explore how cultural dispositions might shape the uptake of emerging risk-reduction and HIV-prevention strategies.

3.5.3. Limitations

Although the present study provides insight into the social and sexual behaviour of GBM, readers should be aware of several important limitations. First, this data was collected using RDS and may therefore be biased towards greater social engagement and community altruism. However, considering that the present study focused on the venues GBM attend, RDS is likely preferable to Internet- or venue-based sampling. Further, because RDS weights were not used in the present analysis, this sample is analogous to other non-adjusted chain-referral samples—where recruitment conditions may influence salient factors considered in this analysis. As such, I recognize that the large number of seeds (n = 119), unproductive recruiters, and diverse motivations for participating in the study (e.g., financial, altruistic, etc.) may further bias this sample (Forrest et al., 2016). Further, with the emergence of sex seeking apps in 2009, it is likely that the prevalence of online sex-seeking was not in a state of equilibrium across this study's recruitment period (i.e., February 2012 – February 2015). Therefore, it is possible that individuals recruited earlier in the Momentum study were less likely seek sex online than those recruited later in the study, simply as a mechanism of when they were recruited into the study. Alternatively, the recruitment of online seeds later in the study period may have also biased GBM recruited later in the study towards increased online sex seeking

(Lachowsky, Lal, et al., 2016). Either way, additional research and analyses are needed to understand how app use has impacted patterns of connectedness among GBM. Second, the variables used to assess online sex-seeking specifically dealt with sex seeking, while other connectedness variables did not assess intent of use. As some GBM may use apps and websites without the intent to find sexual partners (Goedel & Duncan, 2015), the present study may underestimate app or website use among for these individuals. Third, although patterns of connectedness were correlated with measures assessing collectivism, LCA classes did not directly measure the cultural orientations hypothesized by Douglas (Douglas, 1976). Although latent classes might indirectly measure elements of culture, acting as potential signals supporting the importance of cultural biases, the findings of the present analysis highlight significant overlap in the ways diverse GBM connect to their communities. Other authors have conducted analyses which highlight greater heterogeneity in the cultural orientations of GBM (Noor et al., 2017). The associations presented here may therefore average over participant characteristics, obscuring important and relevant findings. This is particularly true when considering the use of LCA. Future studies should directly test these latent constructs using measures designed specifically for this purpose. Indeed, the results of the present study are merely suggestive of underlying latent constructs and additional work is needed to define, explore, and operationalize these constructs. Finally, with respect to the seroadaptive strategies assessed in the present study, dichotomous measures of period prevalence may not sufficiently capture the frequency or consistency of use as they are employed by GBM. Future studies should examine how patterns of connectedness relate to within-person variance in the sexual behaviours these GBM employ.

3.6. Conclusion

The present study highlights important similarities and differences in the ways GBM connect to their communities, which reflects the heterogeneity in the cultural and social attitudes of GBM (as measured by HIV/AIDS stigma and collectivism scores) – one that may be linked to key differences between older and younger GBM (as reflected by the significance of age in predicting class membership). Further, acknowledging previous literature drawing an association between collectivism and risk perception (Dake, 1991; Douglas & Calvez, 1990; Lo et al., 2010a), the present study shows that patterns of

connectedness (measured in the present study using LCA) were associated with GBM's attitudes toward HIV/AIDS (as measured by HIV/AIDS stigma scores) and their HIV/STI testing behaviour. Meanwhile, I did not capture a significant association between patterns of connectedness and seroadaptation (e.g., serosorting, strategic positioning, viral load sorting). These findings may provide insight into the diffusion of specific HIV-prevention strategies and reflect how cultural values held by individuals in different settings may influence which prevention strategies successfully diffuse into the repertoires of GBM.

Chapter 4.

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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Card KG, Lachowsky NJ, Cui Z, Shurgold S, Armstrong HL, Rich AJ, Forrest JI, Gislason M, Moore DM, Roth EA, Hogg RS. 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. AIDS Educ Prev. 2017 Apr;29(2):154-174. doi: 10.1521/aeap.2017.29.2.154. PubMed PMID: 28467159.

4.1. Synopsis

In previous chapters, I have shown that patterns of social behaviour may influence condom use among GBM who seek sex online. Therefore, in the present analysis I sought to identify which interpersonal factors were associated with condom use within the context of online-initiated sexual events. To this end, longitudinal data from GBM enrolled in the Momentum Health Study was used. Follow-up occurred every six months, up to seven visits; at each visit participants reported their last sexual encounter with their five most recent partners. 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. Hierarchical generalized linear mixed models testing for within-subject effects using longitudinal data showed that partner-meeting venue was an important predictor of condom use for HIV-positive, but not HIV-negative men. Generalized estimating equations (GEE), stratified by self-reported HIV status, modeled individual-level, interpersonal, and situational covariates of event-level CAS with partners met online were modeled using. Social (i.e., collectivism, 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. These findings confirm my hypothesis that social behaviours are independently associated with risk-taking among GBM who seek sex online.

4.2. Background

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, 2014). Responding to this epidemic, public health leaders have relied heavily on community-based organizations to establish broad safe-sex norms within gay communities (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 last 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 (Grov, Breslow, et al., 2014). Meta analyses of these studies suggests that men who seek sex online are more likely to report engaging in CAS (Lewnard & Berrang-Ford, 2014; Liau et al., 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 et al., 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, I have previously compared men who seek sex online with those who do not (Card, Lachowsky, Cui, Shurgold, et al., 2016b). 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, and had higher collectivism. 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) and underscores the need to look at broader patterns of social connection, particularly among men who are more reliant on "post-gay" networks.

We hypothesize that these social attachments might also play an important role in shaping their sexual behaviour. After all, the social construction of individual's attitudes, risk perceptions, and behaviour 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; J. D. Fisher, 1988). Applying social perspectives to the examination of sexual behaviour between men who meet online may therefore help us to (i) identify the underlying causes of risky sexual behaviour between men who meet online and (ii) understand how social influence can be leveraged to promote sexual health in online environments.

4.3. Methods

4.3.1. Study protocol

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, Lal, et al., 2016; D. M. Moore et al., 2016), this cohort used respondent-driven sampling (RDS) to recruit men from Vancouver's GBM community. Eligibility criteria included gender self-identified men (including trans men), aged $\geq$16 years, who lived in Metro Vancouver, reported sex with a man in the past six 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 six-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 six months, received an HIV rapid-test or had HIV-relevant bloodwork, 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.

4.3.2. Dependent variables

To assess the primary outcome of interest event-level questions asked participants: “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 behaviours (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 behaviours, 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.”

4.3.3. 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 GBM community, and scales assessing emotional attachment to the GBM community. Specifically, I 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 six 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 GBM 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 (six months). Scales measuring important dimensions of emotional connectedness included: collectivism, social support (Lubben et al., 2006), loneliness

(Gierveld & Tilburg, 2006), and communal sexual altruism (O'Dell et al., 2008). **Table 6** provides descriptions of the scales used in this analysis.

Table 6. Details Regarding the Psychosocial Scales Used

Scale	Scale Scoring	Example Item*	Example Responses*
Communal Altruism *(O'Dell et al. 2008)* No. Items: 6 Study α: 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 or disagree 4–Agree somewhat 5–Agree strongly
Sexual Sensation Seeking *(Kalichman and Rompa 1995)* No. Items: 11 Study α: 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
Treatment Optimism *(Van de Ven et al. 2000)* No. Items: 12 Study α: 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
Negative Self-esteem *(Herek and Greene 1995)* No. Items: 7 Study α: 0.90	0–Positive self-esteem to 21–Negative self-esteem	"I sometimes feel useless."	0–Strongly disagree 1–Disagree 2–Agree 3–Strongly agree
Collectivism No. Items: 4 Study α: 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
Lubben Social Support *(Lubben et al. 2006)* No. Items: 3 Study α: 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
Loneliness *(Gierveld and Tilburg 2006)* No. Items: 6 Study α: 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 less 1–Somewhat no 1–Definitely mo
Hospital Anxiety & Depression (*Snaith et al. 2003)* No. Items: 14 Study α'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"	3–Nearly all the time 2–Very Often 1–Sometimes 0–Not at all
Cognitive Escape Motive *(McKirnan et al. 2001)* No. Items: 12 Study α:0.90	4–Low escape motive To 48–High escape motive	Being drunk makes me more comfortable sexually.	1–Strongly disagree 2–Disagree 3–Agree 4–Strongly agree

*Response options may vary or be reverse-scored for some scale items.

In addition to the primary explanatory variables of interest in this analysis, I also included scales accounting for the possible confounding effects of sexual sensation seeking (Kalichman & Rompa, 1995), cognitive escape (McKirnan, Vanable, Ostrow, & Hope, 2001), treatment optimism (Van de Ven et al., 2000), negative 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 behaviour 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 two hours prior to sex were included, as these 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, I also considered 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*).

4.3.4. Data 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 S1**). As a first step to model building, I used principal component analysis (PCA; (Jolliffe, 2002) to construct an appropriate measure for community and social involvement that captured patterns in GBM community participation, rather than attendance at a single activity or event. PCA results identified two principal components outlined in **Table 7**. 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).

Table 7. Descriptive Statistics and Principal Component Analysis of Community and Social Factors

	Online-initiated		CAS		PCA	
	N	%	N	%	PC 1	PC 2
Social Time Spent with Gay Men					44	5
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		
Attend Gay-Bars/Clubs, P6M					60	-3
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		
Play on Gay Sports Team, P6M					25	-3
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		
Attend Gay-Specific Groups, P6M					-10	68
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		
Read Gay Newspapers/Magazines, P6M					15	30
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		
Pride Parade Participation, P12M					28	22
No	202	36.2	89	40.6		
Yes, spectator	279	50.0	103	47.0		
Yes, in or volunteer	77	13.8	27	12.3		

CAS = “Condomless Anal Sex”; PCA = “Principal Component Analysis”; PC = “Principal Component”; P6M = "Past Six Months"; P12M = "Past Twelve Months"

Recognizing that the rationale for condom use differs significantly according to HIV status, the present data were stratified by self-reported HIV serostatus, and separate analyses were conducted for HIV-negative/unknown and HIV-positive men with online-met partners. General estimating equations (GEE) 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’ $\leq$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 $p \leq 0.20$ and then manually removing variables with the highest Type-III *p*-values until the Quasi-Akaike Information Criteria (QIC) were optimized (minimized).

An additional general linear mixed model (GLIMMIX), using longitudinal event-level data from participant's baseline and follow-up visits was also constructed to examine whether there was a within-subject effect of where partners were met on condom use. Data for this analysis was collected by asking participants at each visit to provide details regarding their most recent sexual event with their five most recent male partners. GLIMMIX models included three clustering variables (i.e., RDS-Chain, Respondent, visit number) to account for sampling and analytic features of the study. GLIMMIX Models were also stratified by HIV status based on research showing differential effects for HIV-positive and HIV-negative men. As such, models also included a variable to account for the event-level partner's HIV status. Finally, models were adjusted for age, as a potential confounder variable (i.e., both online sex seeking and condom use are related to age), and to account for the large difference in the median age of the HIV-positive and HIV-negative samples).

4.4. 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 $\leq$ seven 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, the present 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 six 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.

Table 8. Bivariate Associations for Within-Person Effect of Partner Meeting Venue and Event-Level Incidence of Condomless Anal Sex

	OR	95%CI		aOR	95%CI	
HIV-Positive Events						
Online-Initiated Partnership						
No	Ref			Ref		
Yes	1.62	1.19	2.20	1.54	1.10	2.15
HIV-Negative Events						
Online-Initiated Partnership						
No	Ref			Ref		
Yes	1.63	1.61	1.65	1.15	0.94	1.41

Adjusting for RDS-Chain, Participant Age, Event-Level Partner's Known or Perceived HIV-Status, Number of Sexual Events with Event-Partner in P6M, Months Since First Sexual Event with Event-Level Partner.

Table 8 provides results for within-subject analyses testing whether CAS was more likely with online-met partners. Event-level data for this analysis were reported during one of seven visits by 539 HIV-negative and 221 HIV-positive men and described 5,909 events for HIV-negative men and 2,210 events for HIV-positive men. Among events reported by HIV-negative men, 50.9% were initiated online, 28.6% involved CAS, 31.7% were with partners with an unknown HIV status, 6.4% were with partners the respondent knew or believed was serodiscordant, the median number of months since the first sexual event was four (Q_1, Q_3 = 1, 11), and the median number of previous sexual events in the past six months was two (Q_1, Q_3 = 1, 5). Among events reported by HIV-positive men, 40.6% were initiated online, 56.9% involved CAS, 27.3% were with partners with an unknown HIV status, 24.5% were with partners the respondent knew or believed was serodiscordant, the median number of months since the first sexual event was five (Q_1, Q_3 = 2, 35), and the median number of previous sexual events in the past six months was 2 (Q_1, Q_3 = 1, 5), 31.7%. After correcting for study-design limitations, multivariable results showed that there was a within-subject effect for HIV-positive, but not HIV-negative men.

HIV-negative/unknown men. Descriptive statistics, univariable associations, and multivariable associations for condom use among HIV-negative/unknown men are provided in **Table 9**. In multivariable GEE modeling of events reported by HIV-negative/unknown men, CAS was more likely among men with incomes between $30,000 to $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 collectivism, communal sexual altruism, and social embeddedness PCA scores. In addition to these primary factors of interest, CAS was associated with lower negative self-esteem scores, higher treatment optimism, higher sexual sensation seeking, and having had more recent sexual partners. Increasing frequency of seeking sex online was negatively associated with CAS. On the event-level, CAS was associated with having had more sexual events with the partner in the past six 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.

Table 9. Descriptive, Univariable, and Multivariable Statistics for Event-Level Condomless Anal Sex among HIV-Negative/unknown MSM

	Baseline Online-initiated (N=414 MSM)		CAS (N=127 MSM)		All Visits Univariable			Multivariable		
	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	26.0	Ref			Not selected		
White	308	74.4	94	74.0	1.25	0.89	1.74			
Highest Formal Education										
≤ High school	62	15.2	23	18.3	Ref			Not selected		
> 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	30.0	43	33.9	1.23	0.99	1.54	1.31	1.01	1.69
≥60,000	62	15.0	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										
No. of MSM Known	*40*	*20,100*	*35*	*20,100*	1.00	1.00	1.00			
No. of MSM Known Well	*15*	*7,30*	*20*	*8,30*	1.03	1.00	1.05	1.03	1.00	1.05

Communal Sexual Altruism Scale	*3.50*	*3.00,4.00*	*3.17*	*2.83,3.67*	0.46	0.38	0.56	0.62	0.51	0.75
Collectivism	*8*	*6,9*	*7*	*6,9*	0.90	0.86	0.95	0.93	0.89	0.98
PC 1: Embeddedness	*3.08*	*1.91,4.16*	*2.84*	*1.63,4.03*	0.86	0.79	0.94	0.87	0.79	0.96
PC 2: Involvement	*2.52*	*1.79,3.43*	*2.32*	*1.68,3.14*	0.87	0.79	0.96	Not selected		
Social Support	*11*	*9,13*	*11*	*9,13*	0.99	0.95	1.03			
Loneliness Scale	*2*	*1,4*	*2*	*0,4*	1.00	0.94	1.06			
Sexual Risk Factors										
Used 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	0.40	0.28	0.58	0.59	0.39	0.89
# Male Anal Sex Partners, P6M	*4*	*2,8*	*5*	*3,15*	1.01	1.01	1.02	1.01	1.00	1.02
HADS-Anxiety Scale	*8*	*5,10*	*7*	*5,11*	1.00	0.97	1.03			
HADS-Depression Scale	*3*	*1,5*	*3*	*1,5*	1.01	0.97	1.04			
Negative Self-Esteem Scale	*7*	*4,9*	*6*	*3,8*	0.99	0.97	1.02	0.97	0.94	0.99
Treatment Optimism Scale	*24*	*20,27*	*25*	*21,28*	1.08	1.05	1.10	1.05	1.02	1.08
Sensation Seeking Scale	*31*	*28,33.5*	*32*	*29,35*	1.11	1.08	1.15	1.08	1.04	1.12
Cognitive Escape Scale	*28*	*24,32*	*29*	*24,33*	1.02	1.00	1.04	Not selected		

	Baseline				All Visits (n=3133 Events)					
	Online-initiated (N=995 Events)		CAS (N=300 Events)		Univariable			Multivariable		
	N	%	N	%	OR	95%CI		aOR	95%CI	
Situational Factors										
No. of Events with Partner, P6M	*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	*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	14.0	Ref			Ref		
Home of either Partner	868	87.2	258	86.0	1.44	1.15	1.81	1.34	1.06	1.71
Knew HIV Status of Partner										
Did not know	271	27.2	47	15.7	Ref			Ref		
Knew he was HIV-negative	338	34.0	108	36.0	3.04	2.32	3.97	2.43	1.80	3.28
Thought he was HIV-negative	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	13.0	4.90	3.42	7.03	3.77	2.54	5.58
Thought he was HIV-positive,	4	0.4	0	0.0	2.90	1.37	6.15	2.44	1.14	5.21
Comparative Age to Partner										
Younger	312	31.4	107	35.7	Ref					
Same	314	31.6	84	28.0	0.92	0.75	1.12			
Older	369	37.1	109	36.3	0.98	0.78	1.22			
Event-Level Substance Use										
Alcohol	337	33.9	95	31.7	1.20	1.01	1.42	1.35	1.11	1.64

Marijuana	186	18.7	66	22.0	1.36	1.11	1.66			
Poppers	181	18.2	69	23.0	1.60	1.29	1.98	1.40	1.10	1.80
Erectile Dysfunction Drugs	61	6.1	30	10.0	1.74	1.28	2.37			
Crystal Meth	40	4.0	28	9.3	3.36	2.15	5.25	2.83	1.64	4.90
GHB	25	2.5	17	5.7	2.55	1.65	3.96			
Ecstasy/MDMA	26	2.6	14	4.7	1.71	1.11	2.63			

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; P6M = Past Six Months

HIV-positive men. Descriptive, bivariable, and multivariable results for HIV-positive men are provided in **Table 10**. In multivariable GEE modeling of events reported by HIV-positive men, CAS was negatively associated with age, having a non-gay 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.

Table 10. Descriptive, Univariable, and Multivariable Statistics for Event-Level Condomless Anal Sex among HIV-Positive MSM.

	Baseline				All Visits					
	Online-initiated (N=144 MSM)		CAS (N=92 MSM)		Univariable			Multivariable		
	N	%	N	%	OR	95%CI		aOR	95%CI	
Individual-Level Factors										
Age	*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										
≤ High school	28	19.7	13	14.4	Ref			Ref		
> 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			
Social Factors										
No. of MSM Known	*70*	*30,200*	*80*	*30,200*	1.00	1.00	1.00			

No. of MSM Known Well	*20*	*8,50*	*20*	*7.5,50*	1.01	0.98	1.04			
Communal Sexual Altruism Scale	*2.83*	*2.17,3.83*	*2.67*	*2.00,3.50*	0.60	0.48	0.76	0.60	0.47	0.77
Collectivism	*8*	*6,9*	*8*	*6,10*	0.97	0.91	1.04			
PC 1: Embeddedness	*2.68*	*1.52,3.63*	*2.90*	*1.57,3.78*	1.01	0.87	1.18			
PC 2: Involvement	*2.97*	*2.03,4.42*	*3.25*	*2.06,4.44*	1.04	0.92	1.19			
Social Support	*10*	*8,12*	*10*	*8.5,12*	1.01	0.95	1.07			
Loneliness Scale	*3*	*1,5*	*3*	*1,5*	0.99	0.91	1.09			
Sexual Risk Factors										
Used Apps or Websites to Seek Sex, P6M										
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			
# Male Anal Sex Partners, P6M	*6*	*2,20*	*9*	*3.5,25*	1.00	1.00	1.01			
HADS-Anxiety Scale	*8*	*5,11*	*8.5*	*5,11*	1.00	0.96	1.04			
HADS-Depression Scale	*5*	*2,7*	*5*	*2,8*	1.02	0.97	1.07			
Negative Self-Esteem Scale	*7*	*3,9*	*7*	*4,9*	1.03	0.99	1.09	Not selected		
Treatment Optimism Scale	*29*	*26,33*	*30*	*27,33*	1.04	0.99	1.08			
Sensation Seeking Scale	*32*	*29,35*	*33*	*30,36*	1.12	1.06	1.18	1.11	1.04	1.18
Cognitive Escape Scale	*31*	*27,36*	*33*	*29,37*	1.03	1.00	1.05			

	Baseline				All Visits (n=928 Events)					
	Online-initiated (N=303 Events)		CAS (N=190 Events)		Univariable			Multivariable		
	N	%	N	%	OR	95%CI		aOR	95%CI	
Situational Factors										
No. of Events with Partner, P6M	*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	*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	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	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	16	5.3	14	7.4	5.30	2.42	11.58	6.45	2.60	15.99
Comparative Age to Partner										
Younger	64	33.7	105	34.7	Ref			Not selected		
Same	60	31.6	113	37.3	1.47	1.02	2.12			
Older	66	34.7	85	28.1	1.77	1.11	2.83			
Event-Level Substance Use										

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	1.67	1.21	2.31	1.73	1.16	2.57
Erectile Dysfunction Drugs	87	28.7	62	32.6	1.82	1.31	2.52	2.06	1.33	3.18
Crystal Meth	102	33.7	80	42.1	2.21	1.50	3.28			
GHB	47	15.5	36	19.0	1.97	1.21	3.21			
Ecstasy/MDMA	24	7.9	16	8.4	0.82	0.36	1.91	0.33	0.11	0.96

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; P6M = Past Six Months

4.5. Discussion

4.5.1. Primary findings

In the present study, 1,298 sexual events between MSM who first met online were analyzed. 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 which indicate 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, the present findings support previous evidence suggesting that behaviour 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).

Furthermore, regarding the association between partner-meeting venue and condom use, results show that the within-subject association was significant for only HIV-positive men, and not HIV-negative men. While these findings add clarity to a recent systematic review by Melendez-Torres et al. which found that online sex seeking is inconsistently linked with risky sex in within-person studies (Melendez-Torres et al., 2015), they also highlight the fundamental importance of understanding how GBM employ seroadaptive risk management strategies to prevent HIV transmission – and underscore the importance of examining the individual-level, interpersonal, and environmental factors that shape GBM's behaviour.

Beginning with individual-level factors, I 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., 2016b), these factors likely moderate the relationship between Internet dating and CAS (Horvath et al., 2006; Matarelli, 2013). Likewise, higher treatment optimism and substance use have also been associated with both online sex seeking and risky sexual behaviour (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.

I 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 behaviour within these groups. Indeed, previous research has shown how sexual expectancies, norms, and behaviours vary between gay sub-cultures (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 (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 GBM community might also influence sexual behaviour. In the present analysis, I observed that for each 1-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 behaviour, I suggest that the protective effects observed in the present analysis are likely the product of greater acceptance of prevention messaging (CIHI, 2008) and social norms which encourage risk management behaviour (O'Dell et al., 2008). For instance, I 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, I also note that the impact of normative influence depends on whether or not peer norms are consistent with risk reduction (Fisher, 1988). For instance, I 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 sub-groups of varying levels of community connectedness, to establish consistent norms throughout the GBM 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 behaviour of HIV-positive men, I 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 behavioural 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 behaviour. 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 the present 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 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., 2016), 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 some online venues

facilitate serodisclosure and seroadaptive behaviour (Berry et al., 2008a), 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).

4.5.2. Implications

As other researchers have noted that the Internet may pose significant risk by bringing together individuals from sub-groups with incompatible sexual norms (B. D. Adam et al., 2008a, 2008b), the present analysis highlights the Internet as a prime target for socially-driven HIV-prevention. The U.S. Center for Disease Control and Prevention (CDC) has identified a number of high-impact strategies that might potentially be adapted to online settings (CDC, 2015). As I observed that condom use among HIV-negative/unknown men with online-met partners seems to be influenced by social norms, I 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 sexual, testing, and treatment norms (including those which emphasize the preventative benefits of PrEP). Further, the present 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 behaviours (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).

4.5.3. Future research

The results of the present study highlight the value in examining how social factors shape prevention-related behaviours. 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 behavioural 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 behaviour among MSM. Future analyses are also needed to help us understand how the Internet can be used to facilitate safer sex practices, establish compatible sexual norms, and promote a sense of community among MSM who engage in online-based interactions.

4.5.4. Limitations

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). As such, readers should be cautious when looking at marginally significant associations, as these may arise primarily due to the social network structure and interdependence of observations within recruitment chains. Further, the present 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 the present event-level data is unclear, I 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 last six months, it is possible that the events sampled are not representative of their typical behaviour. The present data structure is also limited by the inability to determine whether events reported at different study visits were with the same partner or with different partners. Additionally, the exclusion of variables which might also predict condom use subject the present study to omitted variable bias.

4.6. Conclusion

Despite these limitations, the present 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.

Chapter 5.

Does Collectivism, via Sexual Sensation Seeking and Sexual Altruism, Confound the Association Between Online Sex Seeking and Condomless Anal Sex?

5.1. Synopsis

Based on findings from the previous chapters, I hypothesized that greater risk-taking in online environments might be due to the uptake of OSS by GBM with lower collectivism. This hypothesis was based on previous research showing that higher collectivism predicts lower uptake of Internet-enabled technologies as well as greater risk aversion. Furthermore, based on previous research examining the interpersonal factors predicting CAS during online initiated events, I hypothesized that the effect of collectivism on the relationship between OSS and CAS was operationalized via lower sexual altruism (i.e., other-motivated sexual behaviour) and higher sensation seeking (i.e., internally-motivated sexual behaviour) among GBM who seek sex online. To test my hypotheses, 774 sexually-active GBM, aged $\geq$16 years, were recruited in Metro Vancouver using respondent-driven sampling. Path analysis was used to test whether collectivism, operationalized by lower sexual altruism and higher sexual sensation seeking, confounded the association between OSS and CAS. To quantify this effect, a ratio of bivariate and multivariate effects was taken to determine what proportion of the relationship between OSS and CAS was explained by my conceptual model. In bivariate analyses, a significant association between past six-month OSS (any vs. none) and recent CAS (any vs. none) was observed ($\beta = 0.131$, SE = 0.041, $p = 0.0015$). However, after accounting for my theorized effects, 41.7% of the association was explained and the path between OSS and CAS became non-significant ($\beta = 0.076$, SE = 0.042, $p = 0.071$) — partially supporting my hypothesis that cultural orientations related to OSS and CAS confound the oft noted association between period-prevalent technology use and risk-taking behaviour. Indeed, results show collectivism, operating by increased altruism (but not decreased sensation seeking), serves as a protective factor against OSS and CAS. I, therefore, conclude that community-based interventions that promote altruism and/or encourage GBM with high sensation seeking to employ risk-neutral (or reducing)

pleasure-seeking strategies (e.g., pre-exposure prophylaxis) may provide significant reductions in STI risk associated with online environments.

5.2. Background

5.2.1. Online Sex Seeking and Condom Use

Literature reviews of period-prevalent data by Liau, Millet, and Marks (2006) and of event-level data by Lewnard and Berrang-Ford (2014) show that online sex seeking (OSS) is associated with condomless anal sex (CAS) among gay, bisexual, and other men who have sex with men (GBM; Lewnard & Berrang-Ford, 2014; Liau, Millett, & Marks, 2006). However, results from within-person studies have been mixed (Melendez-Torres et al., 2015), suggesting that while OSS is an indicator of risk-behaviour, individuals might not necessarily engage in greater risk with only partners their online-met partners. Indeed, despite the proliferation of period-prevalence studies documenting an association between OSS and CAS, these studies do not show that individuals are engaging in CAS with the same partners they meet online (e.g., they may engage in CAS with their regular partners, but not casual sex partners). Irrespective of whether CAS occurs within the context of online-initiated events, differences in the prevalence of CAS between men who seek sex online and those who do not, positions online sex-seeking apps and websites as a valuable public health resource for targeting GBM potentially at risk for HIV and other sexually-transmitted infections (STIs).

5.2.2. The Role of Social Factors in the OSS-CAS Relationship

So, the question of what gives rise to the association between OSS and CAS becomes increasingly important – particularly for researchers aiming to develop interventions that are amenable to their target audiences. Indeed, researchers have regularly argued that the Internet may attract individuals who are more likely to engage in CAS (Jenness et al., 2010; Menza et al., 2009), regardless of whether CAS occurs with online-met or offline-met partners. Based on studies conducted over the past two decades, one contributing factor for increased risk-taking among GBM who seek sex online is lower in-person community connectedness, and hence less exposure to public health campaigns promoting sexual health and literacy (Fernández et al., 2007; Grov, 2011; Grov, Rendina, et al., 2014). This is largely due to the fact that public health agencies have

relied on brick-and-mortar community-based organizations for the delivery of STI-prevention among gay men (CDC, 2006). Yet, as OSS becomes increasingly incorporated into gay social life, particular patterns of community connectedness are increasingly subservient to underlying attitudes and cultural orientations that shape patterns of risk reduction. Indeed, my own analyses examining online and offline connectedness among GBM, shows that – with the exception of sero-status disclosure and HIV-testing behaviour – most seroadaptive HIV-prevention strategies have diffused throughout the GBM community regardless of how individuals participate in online and offline venues (Card, Armstrong, Lachowsky, Cui, Zhu, et al., 2017). Instead, I have shown that seroadaptive behaviour is related to attitudes, beliefs, and cultural orientations (Card, Lachoswky, et al., 2016) – particularly within the context of online-initiated events where they are predictive of condom use (Card, Lachowsky, et al., 2017). Other researchers have likewise shown that underlying attitudes and social dispositions bare significant influence on STI risk. For example, van den Boom et al. (2015) demonstrated that site-specific descriptive (i.e., assumed condom use of others) and injunctive (i.e., assumed acceptance of condom use) social norms significantly influence GBM's condom use behaviour – with lower condom use occurring at sexualized venues where individuals perceive decreased prevalence and acceptability of condoms (van den Boom et al., 2015). Together, this evidence suggests that the oft-noted association between OSS and CAS may be confounded by person-level differences between GBM who seek sex online and those who do not.

5.2.3. Collectivism's Role in the Social Production of Risk

This begs the question of what drives these differences. My own research suggests that collectivism (i.e., greater group-influenced self-conception and increased amenability to group norms) may play an important role in shaping patterns of online and offline behaviour. Indeed, I have previously shown that collectivism is higher among those who connect predominantly offline than among those who connect predominantly online (Card, Armstrong, Lachowsky, Cui, Zhu, et al., 2017). These findings are consistent with previous research showing that collectivism is associated with slower diffusion of new technologies – such as apps and websites (Abbasi et al., 2015; Brown, Ikeuchi, Lucas, & III, 2014; Lim et al., 2004; Lo, So, & Zhang, 2010b). This evidence suggests that GBM

who seek sex online may be less collectivistic (i.e., more individualistic), regardless of whether these individuals are building and participating in online communities.

Relatedly, Lo et al. (2010) has also shown that collectivism is associated with greater adherence to traditional sexual attitudes, norms, and behaviours. Others have likewise shown that collectivism is associated with greater risk aversion and adherence to traditionalist values and behavioural practices (Douglas, 2003; Douglas & Calvez, 1990; Post, Underwood, Schloss, & Hurlbut, 2002). Applied to the domain of GBM health, this may suggest that GBM who are more collectivistic may be less likely to engage in CAS.

Considering these dual influences of collectivism, this evidence suggests that it may simultaneously promote adherence to traditional social norms (such as the pressure to use condoms) and lower technology utilization (such as sex-seeking apps and websites). Collectivism may therefore be a potential confounder in the relationship between OSS and CAS. More specifically, I hypothesized that individuals with higher collectivism may be less likely to engage in CAS and OSS, while individuals with lower collectivism (i.e., higher individualism) might be more likely to engage in OSS and CAS – thus giving rise to an association between OSS and CAS that is attributable to a self-selection process.

5.2.4. Mechanisms Underlying the Confounding Effect of Collectivism

With that said, traditional psychosocial models of behaviour suggest that background factors, such as collectivism, do not operate directly (Fishbein & Ajzen, 2009). Rather cultural orientations are believed to shape behaviour by molding attitudes and beliefs about social norms, behavioural controls, and behaviour-specific risks or benefits. Providing two such mechanisms by which collectivism might confound the relationship between OSS and CAS, I have previously identified sexual sensation seeking (defined as a propensity to seek out novel or risky sexual stimulation; Gaither & Sellbom, 2003) and sexual altruism (defined as other-motivated sexual behaviour; Nimmons, 1998) as influential factors shaping GBM's risk for CAS within the context of sexual events between online-met partners (Card, Lachowsky, et al., 2017).

Sexual Sensation Seeking

Regarding the first of these, sensation seeking was described by Zuckerman (2014) as an inherently individualistic (as opposed to collectivistic) personality trait exemplified by individuals who are guided by internally-driven motivations rather than "social conventions" and are "attracted toward a lifestyle that maximizes the opportunity for independence" (Zuckerman, 2014, p. 181). This suggests that sexual sensation seeking might be a salient marker for increased individualism, contrasting it with more collectivistic motivated behaviour such as that which is characterized by sexual altruism.

Sexual Altruism

Indeed, sexual altruism has been said to represent among gay men "a concern for others' well-being which directly affects" one's sexual behaviour (Nimmons, 1998, p. 78) and promotes a greater sensitivity to the risks that one's actions might pose for others. Thus, contrasted with sexual sensation seeking, altruism represents the expression of collectivistic attitudes which maximize interdependence and obligation to others rather than independence – a strong indicator of collectivistic self-construal and social values. These two attitudinal constructs may therefore provide plausible mechanisms by which individualistic and collectivistic cultural orientations might shape an individual's attitude towards condomless anal sex and online sex seeking.

5.2.5. Hypotheses

As such, I hypothesized that lower collectivism, operationalized through higher sexual sensation seeking and lower sexual altruism, might contribute to decreased condom use among GBM who seek sex online relative to those who do not – thus potentially confounding the relationship between OSS and CAS. While other studies have previously identified the confounding effect of sensation seeking on this relationship (Horvath et al., 2006; Matarelli, 2013), to my knowledge no studies have explored these effects together as a possible explanation for the elevated prevalence of CAS among GBM who seek sex online. Therefore, I used path analysis to examine these hypothesized effects within an urban sample of GBM with the overall goal of understanding how cultural orientations are related to patterns of community connectedness and STI risk. In doing so, I believe that increased understanding of these cultural orientations and sexual attitudes can be leveraged to tailor and target

appropriate HIV and STI programming to the venues where potentially at-risk individuals are connecting with one another.

5.3. Methods

5.3.1. Study protocol

The present study analyzed cross-sectional data collected from the baseline visit of the Momentum Health Study (Moore et al., 2016). Momentum participants were recruited using respondent-driven sampling (RDS) between February 2012 and February 2015. Community-mapping (i.e., a qualitative interviewing technique that utilizes maps and drawings to identify the social network structure of a community relative to geospatial and digital venues) was used as a formative step to finalize study protocols (Forrest et al., 2014). Eligibility criteria restricted participation to self-identified men, including trans men, aged $\geq$16 years, who reported any sexual activity with another man in the past six months (P6M) and lived in Metro Vancouver. Initial RDS seeds were selected with the assistance of community-based partners and via advertisements in online venues. Each participant was eligible to recruit up to six other individuals and was compensated $10 CAD for each participant they helped to enroll in the study. All participants provided written informed consent prior to completing a computer-administered questionnaire and were compensated $50 CAD for completion of the study protocol.

5.3.2. Variables

Demographic and Behavioural Factors

Participants provided their age, race/ethnicity, relationship status, annual income, education, and self-perceived HIV status; reported whether they engaged in any condomless anal sex in the past six months (P6M); reported their frequency of online sex seeking over the P6M; reported how many male sex partners they had over the P6M; and completed scales assessing sexual sensation seeking, sexual altruism, and collectivism.

Sexual Sensation Seeking

The Sexual Sensation Seeking Scale (study α = 0.73) consisted of 11 Likert-based questions, with response options ranging from “Not at all like me” (1) to “Very Much like me,” (4). This version of the scale was adapted from Zuckerman’s general sensation seeking scale by Kalichman and colleagues in the mid-1990’s with the goal of developing a scale specifically addressing sexual sensation seeking (Kalichman et al., 1994). It was validated in a convenience sample of urban gay men and was shown to be correlated with substance use, having more sexual partners, CAS, sexual compulsivity, and ‘non-sexual experience seeking’ (Kalichman & Rompa, 1995).

Sexual Altruism

The Sexual Altruism Scale (study α = 0.91) was validated among a convenience sample predominantly composed of African-American GBM (O’Dell et al., 2008). As represented here, this scale consists of 13 Likert-based items (e.g., “Having safer sex is a way I can help protect the next generation of gay men”) assessing ‘other-centered motivations’ for GBM’s HIV-prevention behaviour. Response options ranged from “Disagree Strongly” (0) to “Agree Strongly” (4).

Collectivism

Finally, four items adapted from Luhtanen & Crocker (1991) measured gay collectivism (study α = 0.81) on a four-point Likert scale from “Strongly Agree” to “Strongly Disagree.” (i.e., “Being part of the gay/bisexual/queer community is an important reflection of who I am,” “Being part of the gay/bisexual/queer community has a lot to do with how I feel about myself,” “Belonging to the gay/bisexual/queer community is not a good thing for me.”) and a fourth item measured on a four-point Likert scale from “Not at all important” to “Very Important” (i.e., “How important is it to you to be connected to and involved in the gay community?”). Final Scores, calculated by summing zero-weighted response items, ranged from 0 (Low Collectivism) to 12 (High Collectivism).

5.3.3. Data analysis

RDS-adjusted descriptive statistics were generated in RDSAT v7.1.46 and primary statistical analyses were completed in SAS v.9.4 (SAS, North Carolina, USA). The PROC CALIS function was used to test my hypotheses using path analysis, as these

structural equation models have been proposed as an effective strategy for examining the effects of complex relationships (Gunzler, Chen, Wu, & Zhang, 2013). In summary, path analysis is a general multivariate technique that allows both for the inclusion of latent variables and multi-directional tests (i.e., all factors, including “outcome” factors are adjusted for the effects of linked variables via structural “paths”). This approach was selected because, unlike standard regression analyses, path analysis more easily accounts for the intercorrelations of exogenous and endogenous variables and their direct and indirect effects (Gunzler et al., 2013). Further, path analysis provides superior descriptions of model-fit, based on observed covariance in the data structure by prioritizing functional relationships (Gunzler et al., 2013).

Tests Conducted

In applying path analysis to the present study, several path models were constructed. bivariate path models tested (i) the associations between OSS (any vs. none) and CAS (any vs. none), (ii) sexual sensation seeking and OSS, (iii) sexual altruism and OSS, (iv) sexual sensation seeking and CAS, and (v) sexual altruism and CAS by regressing each explanatory factor on each outcome without the inclusion of other variables. Single-confounder models then tested the confounding effects of (i) sexual sensation seeking, (ii) sexual altruism, (iii) and collectivism on the relationship between OSS and CAS by separately specifying pathways between each of these effects and the two outcomes of interest.

Final Path Model

My final multivariable model assessed whether collectivism, operationalized through sexual altruism and sexual sensation seeking, confounded the association between OSS and CAS (**Figure 10**). This final model was specified by including pathways between OSS and CAS (P_1), collectivism and sexual sensation seeking (P_2), collectivism and sexual altruism (P_3), sexual sensation seeking and OSS (P_4), sexual altruism and OSS (P_5), sexual sensation seeking and CAS (P_6), and sexual altruism and CAS (P_7). Further, as I believed that sexual altruism and sensation seeking were negatively correlated, representing conflicting dispositions, a path (R_1) was included to test for a negative correlation between sexual altruism and sensation seeking.

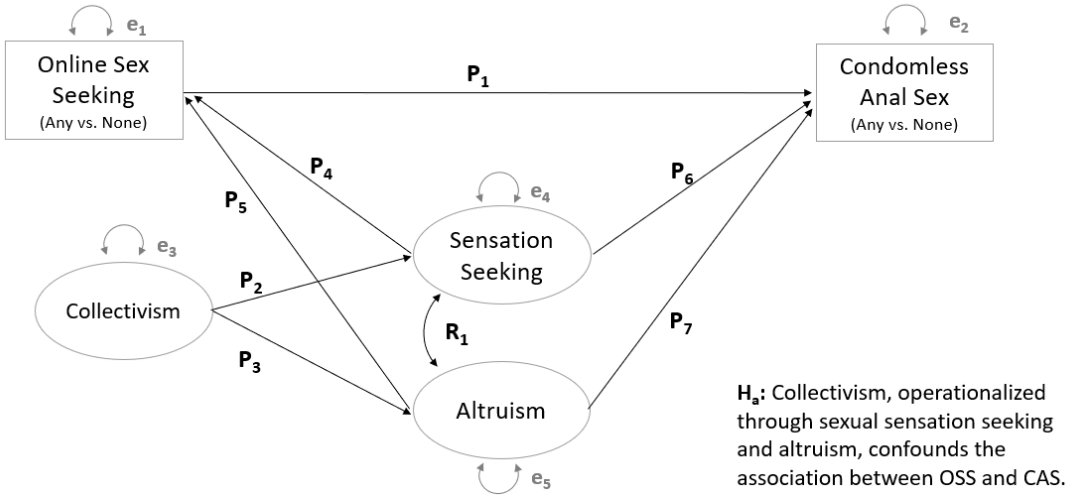

Figure 10. Theoretical Path Model for Mediation of the Relationship Between Online Sex Seeking and Condomless Anal Sex

Inclusion of Scales

In specifying path models, the most salient components of each construct (i.e., altruism, sensation seeking, and collectivism) were identified for inclusion using exploratory factor analysis implemented via the PROC FACTOR function. The top three individual items with the highest correlation for each factor of interest were then modeled as latent variables; thus, allowing us to reduce the number of parameters associated with the specified model (i.e., parsimony). This allowed us to avoid diminishing power and to better assess data-model fit for my primary relationships of interest (Gunzler et al., 2013). While other strategies, such as parceling (i.e., taking the sum or average of scale items), might have provided an alternative approach to reducing model dimensions, parceling is known to inflate measurement invariance and introduce measurement error into the structural model (Bollen & Lennox, 1991; Hall, Snell, & Foust, 1999; Kenny, 1979; Little, Lindenberger, & Nesselroade, 1999; Meade & Kroustalis, 2006; K. A. Moore, Halle, Vandeviri, & Mariner, 2002). Shortening scales by selecting highly correlated variables has been assessed as an acceptable and widely used methodology in structural equation modeling (Hoyle, 2014).

Model Estimation and Fit Assessment

Models were estimated using the weighted least squares (WLS) method to allow for the inclusion of ordinal and binary variables into the model (Muthén, 1984). Statistical fit was assessed using standard fit indices (i.e., χ^2 statistic, Comparative Fit Index [CFI], Root

Mean Square Error of Approximation [RMSEA], and the Standardized Root Mean Square Residual [SRMSR]), and optimized by balancing model parsimony and theoretical integrity against the standard cut-offs for these measures (i.e., χ^2 $p > 0.05$, CFI $\gtrapprox 0.95$, RMSEA $\lessapprox 0.05$; SRMR $\lessapprox 0.05$; Bryan, Schmiege, & Broaddus, 2007; Goffin, 2007; Hooper, Coughlan, & Mullen, 2008). Due to the χ^2 test's sensitivity to large sample sizes (i.e, >200-300), a ratio of the χ^2 value to the degrees of freedom (*df*) was taken (i.e., χ^2/df) with values ≥ 2 indicating "good data-model fit" and values ≥ 3 indicating "acceptable data-model fit" (Schermelleh-Engel, Moosbrugger, & Müller, 2003). A ratio of the relationship between OSS and CAS was taken comparing the bivariate and theoretical models to identify the proportion of the variance explained by the theoretical model.

5.4. Results

5.4.1. Descriptive Results

Overall, 774 GBM, including 14 trans men, were recruited into the sample, of whom 134 were seeds. Crude and RDS-adjusted descriptive statistics for the sample are provided in **Table 11**. The median age of participants was 34 years (Q_1, Q_3: 26,47). Most participants were HIV-negative/unknown (76.2%), white (67.4%), gay-identified (78.8% vs. Bisexual/other), had completed high school (65.0%), and had annual incomes less than $30,000 CAD (74.3%). Overall, 67.7% of men reported online sex seeking in the past six months. Among this group, 67.3% reported condomless anal sex in the past six months, compared to 51.5% of GBM who did not seek sex online (p = 0.0014).

Table 11. Descriptive Statistics

Variable	N (%)	RDS % (95% CI)
Age		
Millennials (≤30 years)	318 (41.09)	39.0 (30.0, 48.3)
Generation X (31-50 years)	340 (43.93)	41.2 (33.9, 49.6)
Baby Boomers (≥51 years)	116 (14.99)	19.8 (12.9, 26.8)
Ethnicity		
White	585 (75.6)	67.4 (60.6, 74.4)
Indigenous	50 (6.5)	10.5 (6.6, 16.0)
Asian	79 (10.2)	10.1 (6.6, 15.7)
Other	60 (7.8)	12.0 (6.1, 15.8)
Sexual Orientation		
Non-Gay Identified (e.g. Bisexual)	119 (15.4)	21.2 (17.1, 28.7)
Gay Identified	655 (84.6)	78.8 (71.3, 82.9)
Highest Education		
Some High School or Less	65 (8.4)	35.0 (27.8, 42.0)
High school or equivalent	114 (14.73)	41.4 (34.2, 48.0)
Greater than high school	595 (76.87)	23.6 (18.6, 30.5)
Annual Income		
$29,999 or Less	485 (62.7)	74.3 (68.8, 79.8)
$30,000 to $59,999	200 (25.8)	18.5 (14.6, 23.4)
$60,000 or More	89 (11.5)	7.2 (3.7, 9.3)
Relationship Status		
Single	477 (61.6)	61.5 (56.7, 69.5)
In a Relationship	297 (38.4)	38.5 (30.5, 43.3)
Self-Reported HIV Status		
Negative or Unknown	556 (71.8)	76.2 (67.2, 81.6)
Positive	218 (28.2)	23.8 (18.4, 32.8)
Sought Sex Online, P6M		
No	188 (24.3)	32.3 (25.5, 38.7)
Yes, Less than once per month	138 (17.8)	18.9 (14.4, 24.7)
Yes, About once per month	97 (12.5)	10.3 (6.3, 14.4)
Yes, More than monthly	351 (45.4)	38.5 (32.2, 45.1)
Condomless Anal Sex, P6M		
No	268 (35.5)	38.3 (30.7, 44.1)
Yes	504 (65.2)	61.7 (55.9, 69.3)
Strategic Positioning, P6M		
No	545 (70.8)	87.8 (82.4, 91.5)
Yes	225 (29.2)	12.2 (8.5, 17.6)
Serosorting, P6M		
No	462 (60.0)	67.3 (60.9, 73.4)
Yes	308 (40.0)	32.7 (26.6, 39.1)
Number of Male Sex Partners	*5 (2 ,14)*	-
Collectivism Score	*8 (6, 9)*	-
Sexual Altruism Score	*6.95 (5.8, 7.7)*	-
Sexual Sensation Seeking Score	*31 (28, 34)*	-

Italics indicate continuous scores with Median (Q_1, Q_3) reported.
RDS-Adjustment Unavailable on Continuous Indicators

5.4.2. Exploratory Factor Analysis for Scales

Results from exploratory factor analyses are provided in **Table 12**. Items with the highest factor correlation with the primary scale factor were selected and are indicated in bold. Selected factor items were included in path models to develop latent variables for sexual sensation seeking, altruism, and collectivism.

Table 12. Exploratory Factor Analysis of the Sexual Altruism Scale, the Sexual Sensation Seeking Scale, and the Collectivism Scale

Scale Items	Factor	
	1	2
Sexual Altruism	Study α = 0.91	
I have safer sex because I want the gay community to survive	0.65	-0.23
The best way to keep HIV/AIDS from infecting gay men is if I practice safer sex	0.68	0.13
Having safer sex is a way I can help protect the next generation of gay men	**0.81**	-0.04
Having safer sex is doing my part to end the epidemic	**0.82**	0.07
Having safer sex is what gay men should do for each other	**0.79**	0.14
Safer sex is everybody's responsibility	0.57	0.27
I don't want any partner of mine to get any disease from me	0.45	0.26
I have a responsibility to stop my partner from doing something risky	0.57	-0.09
Having safer sex is one way for me to teach others about it	0.73	-0.33
Having safer sex shows I care about my partner	0.70	-0.14
I don't want anyone else to have to go through getting infected	0.42	0.25
By having safer sex, I am setting an example for others	0.70	-0.21
Having safer sex is good for my partner as well as for me	0.65	0.15
Sexual Sensation Seeking	Study α = 0.73	
I like wild uninhibited sexual encounters	0.54	0.37
The physical sensations are the most important thing about having sex	0.29	0.25
I enjoy the sensation of sex without a condom	0.36	0.32
My sexual partners probably think I am a risk taker	0.44	0.50
When it comes to sex, physical attraction is more important to me than how well I know the person	0.21	0.28
I enjoy the company of sensual people	0.39	-0.02
I enjoy watching porn	0.23	-0.05
I have said things that were not exactly true to get a person to have sex with me	0.24	0.20
I am interested in trying out new sexual experiences	**0.73**	-0.32
I feel like exploring my sexuality	**0.73**	-0.31
I like to have new and exciting sexual experiences and sensations	**0.78**	-0.30
Collectivism	Study α = 0.81	
Belonging to the gay/bisexual/queer community is not a good thing for me.[A]	0.53	-
Being part of the gay/bisexual/queer community has a lot to do with how I feel about myself.	**0.69**	-
How important is it to you to be connected to and involved in the gay community?	**0.75**	-
Being part of the gay/bisexual/queer community is an important reflection of who I am.	**0.81**	-

BOLDED items indicate factors selected for inclusion into structural model due to highest correlation with main factor. [A] – Reverse Scored

5.4.3. Bivariate Path Models

In bivariate analyses, OSS was positively associated with CAS (β = 0.131, SE = 0.041, *p* = 0.0015). Furthermore, sexual sensation seeking (β = 0.923, SE = 0.208, *p* < 0.001) and sexual altruism (β = -0.593, SE = 0.253, *p* = 0.0191) were associated with OSS; and, as expected, sexual sensation seeking (β = 0.797, SE = 0.303, *p* = 0.0086) and sexual altruism (β = -0.984, SE = 0.149, *p* < 0.0001) were associated with CAS.

5.4.4. Multivariate Path Models

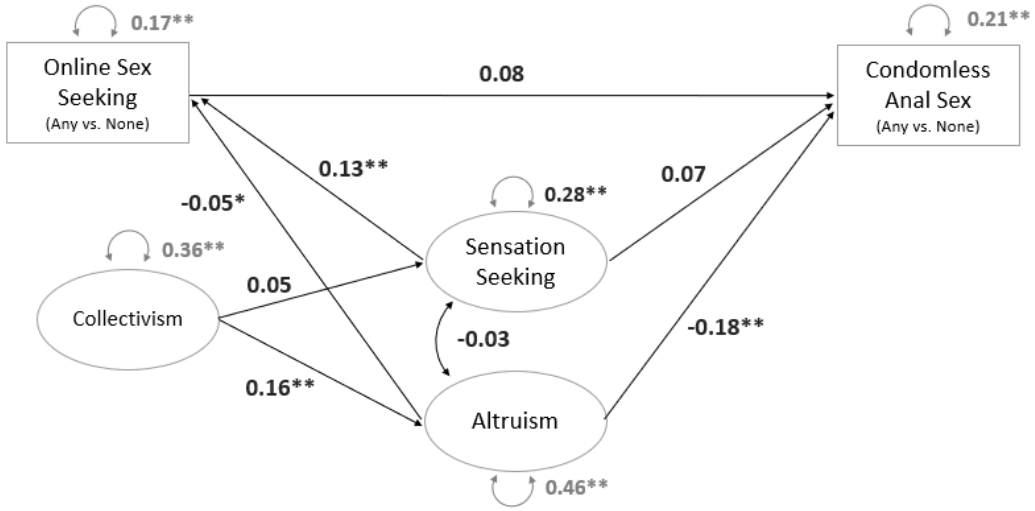

Figure 11. Coefficient estimates for theoretical path model showing the confounding effect of collectivism – operationalized through sensation seeking and altruism – on the relationship between online sex seeking and condomless anal sex.

Table 13 provides model fit and path coefficient estimates for each of the multivariate path analyses examined (See also **Figure 11**). Path models tested the independent effects of sexual sensation seeking and sexual altruism on the relationship between OSS and CAS. In neither of the independent confounding models was the association between OSS and CAS confounded. However, 41.7% of the bivariate association between OSS and CAS was explained by the complete theoretical model and the association between OSS and CAS became non-significant (*p* = 0.0708). More specifically, the association between sensation seeking and OSS (p < 0.0001), as well as the association between sexual altruism and OSS (p = 0.020) were statistically significant. However, only altruism was associated with CAS (p < 0.0001), while the association between CAS and sensation seeking was not significant (p = 0.076).

Table 13. Model Fit and Coefficient Estimates for Structural Equation Models

	χ^2 Data-Model Fit				Other Model Fit Indices			
	χ^2	df	*p*	χ^2 / df	CFI	SRMR	RMSEA	Close Fit
Independent Confounding of Sexual Sensation Seeking	6.87	3	0.08	2.29	0.99	0.02	0.04	0.56
Independent Confounding of Sexual Altruism	9.30	3	0.03	3.10	0.97	0.02	0.05	0.37
Full Theoretical Model	50.50	35	0.04	1.44	0.98	0.03	0.02	1.00
	Unstandardized Coefficients				Standardized Coefficients			
Path	Estimate	se	*t*	*p*	Estimate	se	*t*	*p*
Independent Confounding of Sexual Sensation Seeking								
Online Sex Seeking > Condomless Anal Sex	**0.115**	0.042	2.727	0.006	**0.104**	0.038	2.727	0.006
Sensation Seeking > Online Sex Seeking	**0.920**	0.210	4.388	<.0001	**0.171**	0.038	4.465	<.0001
Sensation Seeking > Condomless Anal Sex	**0.519**	0.240	2.166	0.030	**0.087**	0.041	2.151	0.032
Independent Confounding of Sexual Altruism								
Online Sex Seeking > Condomless Anal Sex	**0.105**	0.042	2.486	0.013	**0.094**	0.038	2.486	0.013
Altruism > Online Sex Seeking	**0.602**	0.259	2.325	0.020	**0.089**	0.038	2.362	0.018
Altruism > Condomless Anal Sex	**1.617**	0.250	6.459	<.0001	**0.215**	0.033	6.496	<.0001
Full Theoretical Model								
P_1: Online Sex Seeking > Condomless Anal Sex	0.076	0.042	1.807	0.071	0.068	0.038	1.806	0.071
P_2: Collectivism > Sensation Seeking	0.049	0.036	1.337	0.181	0.055	0.041	1.337	0.181
P_3: Collectivism > Altruism	**0.158**	0.049	3.234	0.001	**0.138**	0.043	3.201	0.001
P_4: Sensation Seeking > Online Sex Seeking	**0.131**	0.030	4.310	<.0001	**0.164**	0.038	4.359	<.0001
P_5: Altruism > Online Sex Seeking	**-0.054**	0.023	-2.332	0.020	**-0.088**	0.037	-2.370	0.018
P_6: Sensation Seeking > Condomless Anal Sex	0.068	0.035	1.948	0.052	0.076	0.039	1.936	0.053
P_7: Altruism > Condomless Anal Sex	**-0.148**	0.023	-6.526	<.0001	**-0.215**	0.033	-6.622	<.0001
R_1: Altruism <> Sensation Seeking	-0.025	0.015	-1.660	0.097	-0.070	0.041	-1.679	0.093

Bolded estimates indicate statistical significance at assigned cut offs.

Furthermore, collectivism was associated with sexual altruism (p = 0.001), but not sensation seeking (p = 0.181). Finally, the association between sexual altruism and sensation seeking was negative, but not significant (p = 0.097)

Table 14 shows the indirect effects in the full theoretical model. In summary, collectivism (through sexual altruism) had a statistically significant indirect effect on CAS in the full theoretical model (p = 0.027). No other indirect effects were statistically significant.

Table 14. Unstandardized Indirect Effects for Final Theoretical Model

	Theoretical Model	
	Online Sex Seeking	Condomless Anal Sex
Collectivism	0.002	-0.020*
Sexual Altruism	-	-0.004
Sexual Sensation Seeking	-	0.010

* p < 0.05; ** p < 0.01; *** p < 0.001

5.5. Discussion

5.5.1. Primary findings

The present analysis of 774 GBM in Vancouver, Canada found that there was a small increase in period-prevalent CAS accounted for by GBM's use of online venues to find sexual partners over the past six months – a regularly documented finding in the epidemiological literature (Lewnard & Berrang-Ford, 2014; Liau et al., 2006). Furthermore, while the association between OSS and CAS was not confounded by the independent presence of sexual altruism nor sexual sensation seeking, the association was partially confounded by the presence of both factors in the full theoretical path model — suggesting that the association between OSS and CAS can be explained, at least in part, by the uptake of sex-seeking apps and websites by individuals who have higher sexual sensation seeking and lower sexual altruism.

While this study is the first to test the confounding effects of altruism on the relationship between OSS and CAS, previous studies have examined the effect of sexual sensation seeking on this relationship – albeit with mixed results (Coleman, Horvath, Miner, Ross, Oakes, Rosser, et al., 2010; Horvath et al., 2006; Matarelli, 2013). For example, Horvath, Beadnell, and Bowen (2006) found that sexual sensation seeking unexpectedly confounds the relationship between online sex seeking and sexual risk – suggesting that

those with high sensation seeking might use online venues to find safer, rather than riskier, sexual encounters. Conversely, Matarelli et al (2013) found that higher sexual sensation seeking scores are associated with a three-fold increase for CAS among GBM who sought sex online. The findings of the present study contribute to this body of literature by showing that sensation seeking has a confounding effect on the relationship between OSS and CAS – in fact, the effect of sexual sensation seeking on CAS operated primarily through contributing to increased OSS. This suggests that the novelty associated with meeting (new) partners online, might be a prime motivator for OSS by GBM with high sensation seeking.

Furthermore, my results help to contextualize sexual sensation seeking and altruism by showing that both were positively associated with gay collectivism – though only the association between collectivism and sexual altruism was statistically significant. Though I initially hypothesized a negative association between collectivism and sensation seeking, my results suggest that sensation seeking might serve as a motivator for increased collectivism (i.e., perhaps due to these individual's increased desire to connect with their communities in search of potential sexual partners). While I did not examine whether this was the case, I did observe that the association between collectivism and altruism was stronger than the association between collectivism and sexual sensation seeking – suggesting a stronger link between collectivism and altruism compared with sensation seeking and altruism. This suggests that collectivism is amenable to both sensation seeking and altruistic *personality traits* (for lack of a better word) – and not necessarily conversely related to sensation seeking as initially hypothesized. Indeed, while there is likely a natural tendency for altruistic persons to also be collectivistic, Agrusa et al. (2007) suggests that participation in collectivistic activities has the potential to fulfill the needs of sensation seekers as well (Agrusa, Maples, Kitterlin, & Tanner, 2007) – though, one might argue that participation is motivated by different needs. This supports theoretical work suggesting that individualists are more entrepreneurial in leveraging social relationships for personal fulfillment (Douglas & Calvez, 1990). While these individuals have a strong sense of belonging, they do not necessarily respond to social pressures that prompts altruistically-motivated sexual behaviour – potentially explaining the inverse, albeit statistically insignificant, relationship between sexual altruism and sexual sensation seeking. With that said, while collectivism, altruism, and sensation seeking each play an important role

in shaping each other and other risk-related behaviours (such as CAS and OSS), these relationships appear to be non-deterministic and non-mutually exclusive.

5.5.2. Implications & future research

While the stability of altruism and sensation seeking are poorly understood, especially in light of evidence suggesting that these traits stabilize with the development of the prefrontal cortex in adolescence and early adulthood (Choudhury, 2009; Nelson & Guyer, 2011; Romer, 2010); and despite some evidence suggesting that stable personality traits are resistant to social intervention (Derksen, Maffei, & Groen, 1999), the results of the present study do provide important implications for sexual health promotion in online environments. For instance, the increased levels of sensation seeking among GBM who seek sex online suggests that prevention campaigns targeting these venues may benefit from sex-positive messaging which may be more amenable to GBM with sensation seeking characteristics. Given the demonstrated salience of the social constructs examined in the present study, future studies should examine other factors associated with sexual altruism and sexual sensation seeking. Particularly, event-level studies are needed to examine how other salient factors (e.g., partner HIV status, relationship to partner, substance use) interact with cultural orientations and sexual attitudes to influence patterns of STI risk. Within-person studies can also provide nuance into understanding how specific individuals interact with online and offline met partners to identify potential differences (Melendez-Torres et al., 2015). Furthermore, additional research is needed to examine how best to promote altruistic beliefs and provide risk-neutral options (e.g., pre-exposure prophylaxis) that satisfy the needs of those with high sexual sensation seeking (David, McMahon, Luthar, & Suchman, 2012; Teva, Bermúdez, & Buela-Casal, 2010). Doing so may significantly reduce the risks associated with online environments by providing prevention messaging that is culturally sensitive to the dispositions, attitudes, and beliefs of GBM who patronize these online venues. I also underscore the need to better understand how psychosocial interventions might be leveraged to change key attitudes and behaviours by addressing underlying values and personality traits, such as collectivism. These include both therapeutic interventions – such as motivational interviewing (Parsons, Lelutiu-Weinberger, Botsko, & Golub, 2014), cognitive behavioural therapy (Melendez-Torres et al., 2015), and acceptance and commitment therapy (Moitra, Chan, & Stein, 2015) – and social/mass

media campaigns which seek to promote health-promoting values (Bahia & Simintiras, 2016; Wakefield, Loken, & Hornik, 2010). Furthermore, given that many individuals with higher collectivism continue to use online venues to find sexual partners, future research should examine the ways in which online venues might fulfill the needs of both individualistic and collectivistic individuals.

5.5.3. Limitations

When considering these findings, readers should be aware of several limitations. First, while RDS-weights were used for descriptive statistics, they were not used in the primary analyses. This was done primarily for two reasons: (i) path analysis only allows for a single individual-level weighting-matrix which cannot be efficiently generated in current RDS-software; and (ii) the impact of including sample weights in path models is not well understood, making it difficult to assess how sample weights impact path estimates, standard errors, and model fit indices (Hahs-Vaughn & Lomax, 2006). Consistent with this limitation, the analytic component of this analysis should be considered with respect to the differences between crude and RDS-adjusted estimates (McCreesh et al., 2012) – which, except for ethnicity, did not meaningfully differ. Secondly, altruism, sensation seeking, and collectivism were included into path models using the highest correlated variables, rather than the full validated scales. Therefore, the constructs assessed in the present paper, while theoretically consistent, may lack some features of the previously validated scales from which latent indicator items were taken. Third, as cross-sectional data were used for the present study, I was not able to assess temporal ordering of hypothesized pathways. While the literature on sexual altruism and sensation seeking supports my temporal ordering of events in the hypothesized model (O'Dell et al., 2008; Zuckerman, 2014), it remains possible that GBM's attitudes towards their sexual behaviour are developed post hoc, thereby reversing the causal ordering operationalized in my models (Kenny, 1979). Indeed, while path models are sometimes interpreted as causal models, in reality, path analysis has no method for distinguishing between outcomes and explanatory factors (Goffin, 2007). Finally, this study does not consider a number of potentially salient predictors of CAS – such as how familiar participants were with their sexual partners, whether they were of the same HIV status as their partners, whether they employed strategic positioning or similar risk-reduction measures to prevent transmission, or whether they had used drugs or alcohol prior to or during sex.

Most importantly, these data do not indicate whether CAS reported over the past six months was actually with partners whom they had met online – potentially overestimating the association between OSS and CAS. However, as these are inherently event-specific factors, forthcoming event-level analyses are needed to determine how these factors interact with cultural dispositions and attitudes to influence the association between OSS and CAS – perhaps providing a more robust confounding measure than was observed in the present study.

5.6. Conclusion

In conclusion, the present study highlights sexual altruism and sexual sensation seeking as important factors associated with risk-taking behaviour in online sex seeking environments. This supports previous hypotheses which suggest that the relative decrease in condom use among those who seek sex online might be explained by the uptake of online sex seeking among those who are already at increased risk to engage in CAS (Liau et al., 2006). However, as complete confounding was not observed, it remains possible that sex seeking apps and websites also accentuate risk-taking behaviour (Melendez-Torres et al., 2015). Indeed, other media technology studies suggest that individuals are prone to a disinhibition effect whereby individuals experience reduced concern for individuals met online (Lapidot-Lefler & Barak, 2012; Suler, 2004b). It is also possible that the sexualized imagery and nature of online venues might prime individuals for risky sexual behaviour, such as has been described within the context of other high-risk sexualized venues (P. C. G. Adam et al., 2011; Roberts et al., 2014; Skakoon-Sparling et al., 2016). Future studies should examine these potentialities as well as seek to identify other factors which might predispose those who seek sex online to engaging in CAS.

Chapter 6.

Conclusions

6.1. Synopsis

In Chapter 1, I hypothesized the potential influence of community and social factors on GBM's sexual risk-taking in online environments. Testing this hypothesis, the analytic chapters of this thesis sought to examine the relationship between online sex seeking and community connectedness (Chapters 2 - 4), assess to what extent these interpersonal factors facilitate risky sexual behaviour within the context of events between GBM who first met online (Chapter 5), and examine the mechanisms that give rise to differential patterns of risk behaviour among these men (Chapter 6). In this chapter, I provide an overview of findings, propose a theoretical framework representing the mechanisms by which social and cultural factors shape behaviour, acknowledge the strengths and limitations of this thesis, identify implications for research and prevention efforts, and provide a short conclusion.

6.2. Overview of Findings

While it is difficult to parse out the temporal ordering of cause and effect (Schneider, 1987), this thesis underscores the importance of considering the socio-cultural and interpersonal factors that shape GBM's attitudes and behaviour – particularly with respect to those underlying their social, technological, and sexual practice. At the outset of this thesis, I hypothesized that lower community connectedness among GBM who sought sex online was a potential cause for the increased risk associated with online environments. This hypothesis was largely based on previous research showing that community connectedness is a protective factor that promotes sexual health (Frost & Meyer, 2012; Herek & Greene, 1995; Holt et al., 2012; Ramirez-Valles, 2002), that online sex seeking is associated with decreased community connectedness (Grov & Crow, 2012; Grov, Rendina, et al., 2014; D. McKirnan et al., 2007; Zablotska et al., 2012b), and that GBM who seek sex online are more likely to report risky sexual behaviour (Lewnard & Berrang-Ford, 2014; Melendez-Torres et al., 2015).

However, as reviewed in Chapter 1, community and social factors have not been widely tested as confounders of the relationship between online sex seeking (OSS) and condomless anal sex (CAS). Rather, risky sexual behaviour in online environments has largely been considered with respect to GBM's sexual preferences and seroadaptive behaviour (Benotsch et al., 2002; Coleman, Horvath, Miner, Ross, Oakes, & Rosser, 2010; Cruess et al., 2016; Ostergren et al., 2011). Yet, I felt that the Reasoned Action Approach provided strong rationale for investigating the potential influence of so-called "background factors" such as community connectedness (Fishbein & Ajzen, 2011).

With this goal in mind, Chapter 2 showed that previous studies testing the association between Internet use and community connectedness have produced mixed results. While the weight of existing evidence supported my hypothesis that Internet use was associated with lower interpersonal connectedness, I found that the increasingly important role that online venues play in contemporary gay life may be shifting the association between Internet use and connectedness (Card et al., 2016b; Shilo & Mor, 2015). As such, Chapter 3 described patterns of community connectedness among GBM in Metro Vancouver. In doing so, three predominant patterns of online sex seeking were identified. The first was comprised of highly connected and involved GBM (i.e., socialites) who reported seeking sex online. The second was comprised of less connected GBM who relied primarily on the Internet to connect with their communities (i.e., techies). The third group represented GBM with moderate likelihood of in-person connectedness but significantly lower online connectedness (i.e., traditionalists). Examining covariates of these classes, the present study found that they were associated with GBM's perceptions of HIV stigma, testing behaviour, patterns of sero-disclosure, partner frequency, and even condom use (Card et al., 2017). Furthermore, these studies showed that the concept of "gay collectivism" was an important underlying characteristic of the observed latent structure. Indeed, for each 1-point increase in collectivism, the odds of belonging to the traditionalist class dropped by 18% and the odds of belonging to the techie class dropped by 25% (vs. belonging to the socialite class). With scores ranging between 0 and 12, collectivism represented one of the strongest effects observed relating to GBM's patterns of online and offline community connectedness.

Relatedly, Chapter 4 showed that altruism, collectivism, and social embeddedness were important predictors of CAS within the context of online-initiated events. For HIV-positive

men, each 1-point increase in altruism was associated with a 40% decrease in the odds for CAS; and for HIV-negative men each 1-point increase in collectivism, 1-point increase in altruism, and 1-point increase in social embeddedness were associated with a respective 7%, 38% and 13% reduction in the odds for CAS—representing effects comparable to the “attitude” based measures of risk (such as treatment optimism). Similarly, Chapter 5 found that the uptake of OSS among GBM with lower altruism and collectivism and among those with higher sensation seeking explained a substantial proportion (≈40%) of the association between OSS and CAS, and that, in fact, the association became non-significant after accounting for these factors.

6.3. Theoretical Interpretations

In addition to describing the relationship between social, technological, and sexual behaviour, this thesis has undertaken an effort to describe how socio-cultural and interpersonal factors come to shape the behaviour of GBM. In the coming pages, I hope to describe how I imagine sociocultural factors come to shape individuals and their behaviour – a subject that I have yet to address in great detail but is important to this body of work. While it may seem inconsistent to zero in on individuals when trying to argue in favour of a social understanding of health (juxtaposed to a neo-liberal one) – ultimately, I feel it necessary. This is in part due to the emergence of sensation seeking as one of the salient predictors of condom use behaviour and online sex seeking – but there are certainly other reasons as well. Indeed, cultures and communities undoubtedly bring much to bear in terms of shaping the neuronal pathways, dopaminergic functions, and thus behavioural responses of individuals (as I will discuss below). However, the expressions of any social construction (and I would contend that sexual behaviours are the quintessential social construction) must be operationalized by an individual.

This is not simply a reinvention of neoliberalism. Nor should one interpret it as favoritism for positivist approaches which place biology at the center of every debate. Rather, I contend that an accurate model of behaviour must aim to break down the barriers between constituent disciplines of biology, psychology, and socio-anthropology to arrive at a biopsychosocial theory of behavioural production. I believe that if we otherwise attempt to intervene in the sexual practices of GBM who seek sex online (or any other population for that matter) – that is, without attention to the pathways by which cultures and communities have inscribed themselves into the biology that underlies their

behaviour – then we will undoubtedly find ourselves in the fruitless labour of participant colonization (i.e., trying to "promote" our *preferred* behaviours to those who behave differently). To avoid this outcome, I suggest that social and interpersonal influences work to produce behaviour by (1) altering the biological response and function of individuals and (2) acculturating individuals towards specific patterns of thought and belief. An outline of this model is provided in Figure 12 and in the following pages I will provide detailed support for this Biopsychosocial Theory of Behavioural Production.

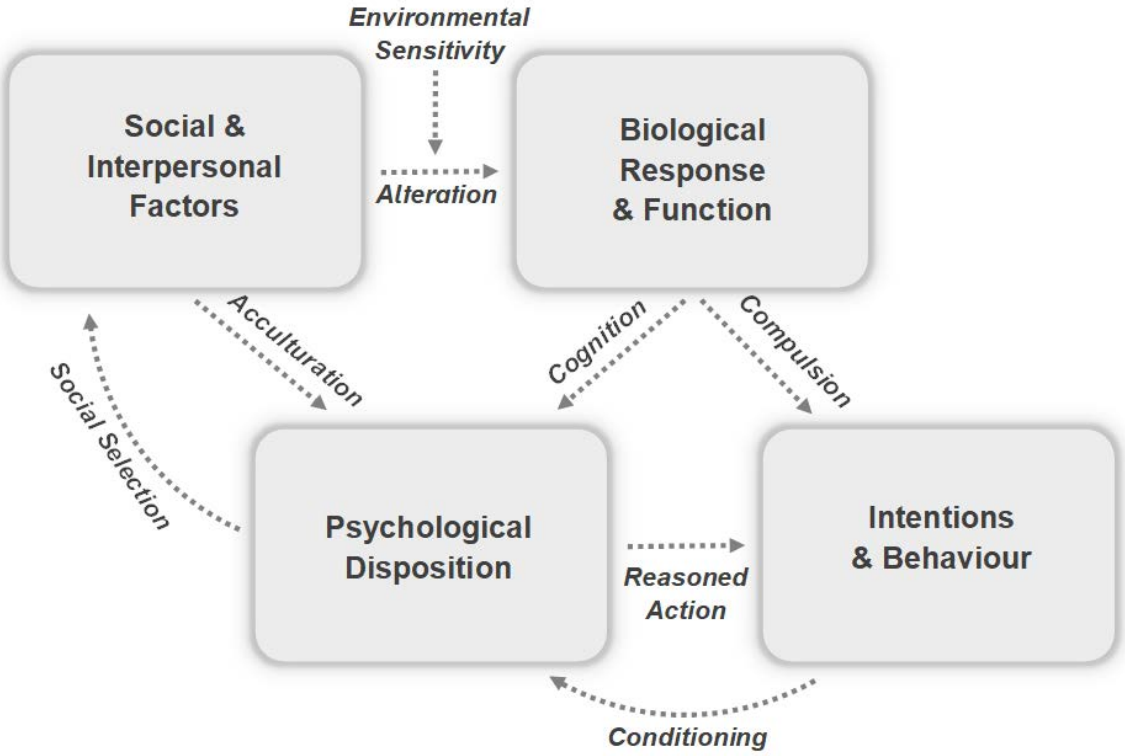

Figure 12. Biopsychosocial Theory of Behavioural Production

6.3.1. Acculturation

Throughout much of this thesis, I have used collectivism (and its twin dipole, individualism) as an example of how social and interpersonal factors help produce certain patterns of behaviour. With respect to this approach, I note that much of the foundational literature in this area compares collectivistic Asian cultures to individualistic Western cultures (Talhelm et al., 2014). The leading theory for this dichotomy has been that particular modes of economic production (i.e., the rice patty and the share crop)

gave way to the coevolution of these cultures and their constituent psychologies (Talhelm et al., 2014).

Relatedly, collectivism and individualism are also thought of as byproducts of two distinct patterns of social organization. Tönnies (1887) and Weber (1922) referred to these two types of social organization as *Gemeinschaft (community) & Gesellschaft (society)*.

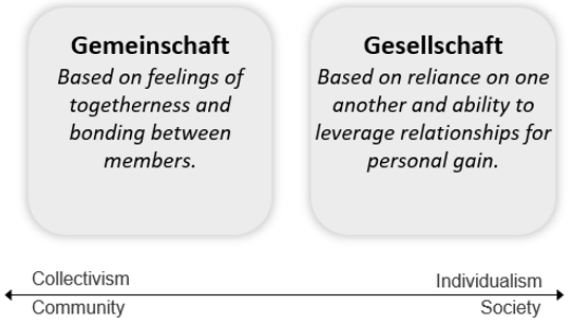

Figure 13. Tönnies Sociological Perspectives on Community and Society

Under this dichotomy (Figure 13), *community* represents the types of social interaction that are defined by personal and intimate relationships (i.e., kinship and fellowship). In these groups, individuals are subservient to the collective welfare, and indeed their identity is a bi-product of the social order. However, the larger a group becomes, the more difficult it is to maintain a sense of community. Role specialization creates the need for greater individualism and ambition. This gives rise to *weaker ties*, which become increasingly more common as individuals are driven by "rational will." Leveraging this sociological framework, Durkheim (1893) described *community* as the quaint (or exotic) social order of the past and *society* as the social order of industrial modernity (See Figure 14).

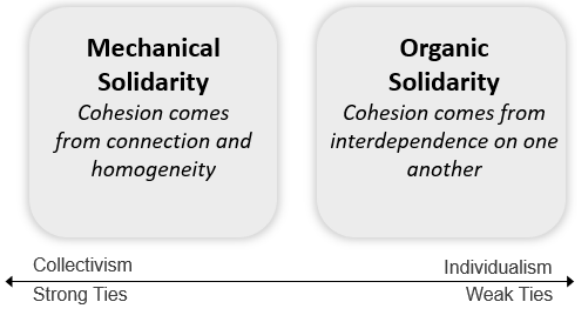

Figure 14. Durkheim's Sociological Perspectives on Community and Society

Inheriting Durkheim's structuralist approach, Bernstein (1977) describes how these patterns of social solidarity operate within the family. Namely, he leverages the concepts of positional and personal control to show how distinct acculturation patterns give rise to distinct psychologies of collectivism and individualism. Families operating under positional control follow categorical rules that depend on the relative position of individuals (e.g., the youngest goes to bed first, the father gets the largest portion, the boys mow the lawn, and the girls help with the dishes). Meanwhile, families operating under personal control rely more on personal feelings and wants (Douglas, 1976). In turn, these two forms of family control are related to two divergent sets of rules (or codes) that underlie language, thought, and social behavior. The first, restricted coding, is often associated with positional family control and is exemplified by rigid syntax. The second, elaborated coding, is often associated with personal family control, and is exemplified by a broader range of syntax (Bernstein, 1977).

These two codes, Bernstein argues, are transmitted to children by their communities and society. Elaborated code allows speakers to better articulate their own feelings. Therefore, when operating within systems governed by personal control, elaborated codes are reflected in statements like: "Don't bother your father, he's tired," "Don't do that, you'll hurt your sister," "Don't eat that, you'll spoil your appetite." These statements make an appeal to personal feeling because the elaborated syntax better articulates the importance of the individual. On the other hand, restricted coding emphasizes social order and transmits information about that order. In the words of Douglas, "If [a child] asks 'Why must I do this?' the answer is in terms of relative position. Because I said so (hierarchy). Because you're a boy (sex role). Because children always do (age status). Because you're the oldest (seniority). As he grows, his experience flows into a grid of role categories; right and wrong are learnt in terms of the given structure; he himself is seen only in relation to that structure" (Douglas, 1976, pp. 24–25).

Interestingly, Bernstein (1977) notes that these forms of social control and syntactic codes follow from the ways social groups are organized and indeed they support "particular forms of significance" (Bernstein, 1977, p. 76). In mechanical communities, the importance of social order emphasizes the need to constantly reinforce the individual's relative position in the group. As social order is strongly imposed on individuals, the restricted syntax relies on shared knowledge and understanding between speakers. Whereas in organic societies, the division of labour gives rise to elaborated

coding, which allows individuals the freedom to pursue their own goals and ambitions. Further, as there is a greater variety of syntactic alternative to choose from, the elaborated code requires less shared knowledge between speakers. Therefore, elaborated coding emerges where the demand for labour specialization is the strongest.[2]

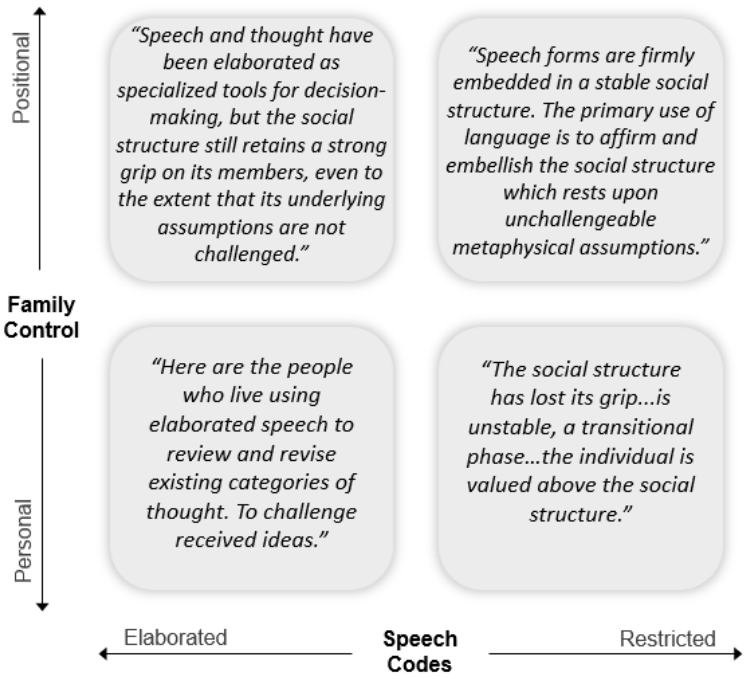

Figure 15. Bernstein's Syntactic Codes

With that said, social control and syntactic codes do not always flow together. You can imagine a situation where a caregiver raised under one form of social control finds themselves raising children in a society or community that reinforces the opposing syntactic code. In this case, a child's view of the world and their place in it might deviate from the expected social pattern of either their caregiver or of the broader society. Applied to GBM, this speaks to those who are raised in a household with one set of norms but find themselves acculturated into a very different community after coming out. Douglas (1976) argues that the intersection of these two constructs give rise to a "hundred, or a million, types of cultural bias" (p. 8) of which she attempts to construct

[2] As a side note, Bernstein found that this was the case in wealthier communities; and, in fact, research since has shown that by the age of four, children from wealthier households have heard over 30 million more words than children from poorer households.(Hart & Risley, 1999) This may, in part, be due to elaborated syntax used by those who are better integrated into society.(Hasan, 2005)

four parsimonious and comprehensive *cultural* categories (as discussed at the outset of Chapter 2) [3].

In turn, these group- and individual-level phenotypes have been shown to reinforce the cultural status quo through selective mating pressures, child rearing, and peer socialization (Creanza, Fogarty, & Feldman, 2012; Zhu, Zhang, Fan, & Han, 2007). They become models for not only groups, but for individuals – perhaps operating in a similar fashion to what Freud (1933) described as the super-ego (i.e., the moralistic, conscientious, and inner critic that checks and balances the carnal id—driving the ego towards compliance with social norms and ideals). Given the strong link between families and acculturation of personal psychologies, it's of little surprise that Freud illustrates the concept of the super-ego by conflating it with that of the father: paternalizing, commanding obedience, standing in the way of the childish wants of the id. However, this conflation is more than mere hyperbole or metaphor. Freud believed that the super-ego is a product of the home—shaped by the pageantry of parenting.

Indeed, this process of identity formation begins early in a child's life and is inseparably rooted in the intimate relationships that infants have with their kin, particularly their parents. Imagine, for a moment: when an infant smiles, her parents are there to smile back; when she cries, they are there with doting sympathy; and when she is angry, they are there with their own frustrations. Children are born and raised with this sort of well-practiced call and response, back and forth, give and take. Indeed, throughout a child's life, parents and children engage in an intricate and delicate ballet of information exchange (Iacoboni, 2009). As a result, this dance increases social bonding between parent and child (Chartrand & Lakin, 2013), and the more bonded two people are, the more they mirror, mimic, and model one another (Chartrand & Bargh, 1999; Meltzoff, 1990). These early stages of cognitive neuronal development are fundamental to shaping the processes that underlie cognition and compulsion and represent at their core a process that I describe in my biopsychosocial model as "acculturation."

[3] It's worth noting that Bernstein and Douglas arrived at these constructs independently, and similar constructs can be seen in Weber's work as well.

6.3.2. Alteration

In addition to the acculturating effects of social influence, I argue that it also has a direct effect on the development of one's biological operation. Indeed, despite my treatment of collectivism as primarily a cultural phenomena, it has been previously linked to neural correlates within the medial prefrontal cortex (Chiao et al., 2009; Harada, Li, & Chiao, 2010a) — suggesting that biological factors bare at least some influence over higher order functions such as risk-perception and self-control. There are even studies showing a correlation between genetic markers and the cultural factors under study in the present thesis. For example, the Dopamine D4 receptor gene (DRD4)[4] is associated with propensities towards altruism (Anacker, Enge, Reif, Lesch, & Strobel, 2013; Bachner-Melman et al., 2005; Kitayama et al., 2014), sensation seeking (Munafò, Yalcin, Willis-Owen, & Flint, 2008), and risk-taking (Kuhnen & Chiao, 2009). Its effect on these functions can be easily linked to its role as an encoding gene for the D4 dopamine receptor subtype abundant in the retina, prefrontal cortex, amygdala, hypothalamus, and pituitary (Di Ciano, Grandy, & Le Foll, 2014) – areas thought to coordinate higher-level cognition, emotional response, long-term memory, behaviour, and reward-based reinforcement learning. Genes, such as the DRD4 dopamine receptor coding gene, underscore the complex relationship between environments and individuals. In other words, they highlight a pathway for syndemic production of behaviour.

Indeed, biologists have identified a variety of pathways by which social bonding impacts development. Neurotransmitters like oxytocin and arginine vasopressin are increasingly acknowledged as important precursors of behaviour that are strongly impacted by the degree of social interaction an individual engages in (Donaldson & Young, 2008; Lieberwirth & Wang, 2014). In turn, a number of longitudinal prospective studies have shown that patterns of infant-caregiver attachment are predictive of a wide array of personal and interpersonal outcomes. These include measures of social competency, IQ, relationship success, life satisfaction, anxiety, emotional control, and psychopathology (Grossmann, Grossmann, & Waters, 2006).

[4] DRD4 is a polymorphic protein-coding gene located on chromosome 11p15.5 with between 2 and 11 repeats (2R-11R). The 7-repeat (7R) allele, has been associated with poorer dopaminergic functioning, with partial loss of DRD4-mediated prefrontal inhibition caused by poorer signaling capacity relative to the more prevalent 4R-allele (Nikolova, Ferrell, Manuck, & Hariri, 2011).

Of course, even given similar processes of biological alteration and social acculturation, not all individuals are expected to perform uniformly. For instance, a moment ago I highlighted the DRD4 allele which was related to several of the outcomes of interest in this thesis (e.g., collectivism, altruism, sensation seeking, risk-taking). However, I neglected to mention that these results have been mixed (Chen, Burton, Greenberger, & Dmitrieva, 1999; Reif & Lesch, 2003). Furthermore, it is not apparent why the 7R-allele would be associated with both "collectivistic" behaviours such as altruism, as well as "self-motivated" behaviours such as risk-taking (Kitayama, King, Hsu, Liberzon, & Yoon, 2016). In other words, why are these effects not more delineating? Why doesn't every collectivistic person use condoms, or every individualistic person avoid them? Why was altruism, but not sensation seeking, associated with collectivism in my structural equation model (Chapter 5)? If they truly do share some genetic basis, we should be expect to see stronger correlations between these factors. One explanation for the mixed findings is that there is a gene-environment interaction in which carriers of the 7R-allele have higher sensitivity to socio-cultural norms (Kitayama et al., 2016; Sasaki et al., 2013). Put another way, in environments where collectivistic norms are reinforced, 7R-allele carriers have a greater than average propensity towards collectivism; while in environments where individualistic norms are reinforced 7R-allele careers have a greater than average propensity towards individualism (Settle, Dawes, Christakis, & Fowler, 2010). Like "acculturation," this process of "alteration" describes how social factors impact specific biological structures or pathways that precede behaviour.

6.3.3. Compulsion

However, unlike acculturation, alteration has the potential to bypass higher order functions that shape behaviour with reduced interference from the prefrontal cortex (which is responsible for "decision-making"; Rendina et al., 2018). To illustrate this, I will again point to the example of the DRD4 7R-allele – which as I've mentioned several times now is strongly related to several of the outcomes of interest covered in this thesis. In again bringing up the DRD4 gene, I should underscore that the 7R-allele polymorphism is associated with less-effective neuronal signaling between the prefrontal cortex (where much of our higher order neural processing occurs) and the limbic-hypothalamus-pituitary-adrenal system (LHPA) axis (where the brain links to other major body systems in regulating stress, emotions, and sexuality). Studies examining the role

of the stress response on decision-making, support the assertion that inhibition of executive control via the prefrontal cortex is related to reduced capacity for inhibition (Arnsten, 2009; Ceccato, Kudielka, & Schwieren, 2016). Thus, it is likely that this gene variant plays an important role in the syndemic production of many health disparities experienced by GBM (Halkitis et al., 2015; Klein, 2011; Ostrach, Lerman, & Singer, 2017; Pollard, Nadarzynski, & Llewellyn, 2017). To illustrate the potential mechanism in greater detail, the 7R-allele is associated with reduced concentration of cyclic AMP, which is necessary to activate HCN-ion channels within neurons (Biel & Michalakis, 2009; Wang et al., 2007). Thus, as these neural communications cannot occur without these HCN-ion channels, there is a weakened D4-response which results in inhibition of the prefrontal cortex (Arnsten, 2009; Wang et al., 2007).

Thus, in individuals with the DRD4 7R-allele (which may be as many as half of all men in North America; Chang, Kidd, Livak, Pakstis, & Kidd, 1996) the regulatory relationship between the limbic system (which is responsible for regulating homeostasis and other autonomic functions of the nervous system) and the prefrontal cortex is degraded. As such, negative cognitive impairment associated with stress is aggravated and downstream processes are disrupted.

Evidence for this disruption can be seen outside the brain by examining the functioning of the LHPA regions – the same DRD4-rich areas introduced earlier. To summarize, normal activation of the LHPA pathway produces cortisol. Via a feedback effect, cortisol then mediates LHPA activity by binding to glucocorticoid receptors in the prefrontal cortex (Veer et al., 2012). This instructs the prefrontal cortex to exert executive control over lower order LHPA functions — thus returning the body to a state of normal stress response. However, if the pathways between the prefrontal cortex and LHPA are malfunctioning (perhaps due to disruption with HCN-ion channels), this feedback cycle can be negatively impacted – resulting in excessive cortisol production (Cozza, 2014). In response to persistently elevated cortisol, the body down-regulates the upstream processes that produces cortisol. This adaptive mechanism results in lower basal cortisol (Buchmann et al., 2014; De Bellis & A.B., 2014; Hensleigh & Pritchard, 2013). While the direct, mediating, and moderating effects of complex LHPA-reactions are only now beginning to be understood, the DRD4 7R-allele has been associated with lower basal cortisol (Armbruster et al., 2009) – highlighting a fundamental connection to the stress response (Lozza et al., 2017; Mehta, Welker, Zilioli, & Carré, 2015; Sladek,

Doane, Luecken, & Eisenberg, 2016). Likewise, sensation seeking (Rosenblitt, Soler, Johnson, & Quadagno, 2001; Shabani, Dehghani, Hedayati, & Rezaei, 2011) and altruism (Pfattheicher, Landhäußer, & Keller, 2014; Shirtcliff et al., 2009) have also been associated with cortisol-levels and cortisol reactivity – suggesting that their noted relationship with the DRD4 polymorphism continues in downstream processes.

However, these associations are nuanced: while lower basal cortisol is associated with sensation seeking (van Honk, Schutter, Hermans, & Putman, 2003), spikes in cortisol-levels are associated with risk-taking (van den Bos, Harteveld, & Stoop, 2009) – likely due to a loss of top-down executive control associated with large spikes in cortisol. This suggests that individuals with high sensation seeking might seek out stimulation to compensate for low basal cortisol, resulting in a cortisol spike that inhibits risk aversion (Arnsten, 2009; Veer et al., 2012) – thus explaining the strong association between sensation seeking and risk-taking (Rosenblitt et al., 2001; Shabani et al., 2011). On the other hand, prosocial behaviour has also been linked to lower basal cortisol levels (Shirtcliff et al., 2009). This is likely because some individuals with lower basal cortisol levels cope by seeking out social connection rather than risky stimulation. This results in greater oxytocin production and the dopaminergic benefits associated therewith (Doom, Doyle, & Gunnar, 2017; Heinrichs, Baumgartner, Kirschbaum, & Ehlert, 2003; Lin et al., 2015; McInnis, McQuaid, Matheson, & Anisman, 2017; Raposa, Laws, & Ansell, 2016; Skuse & Gallagher, 2009; Smith, Mogavero, Tulimieri, & Veenema, 2017; Tops, Koole, IJzerman, & Buisman-Pijlman, 2014). This highlights the context dependency of the 7R-allele and similarly functioning gene variations (Belsky & Beaver, 2011) and provides not only a feasible biological relationship between collectivism, altruism, sensation seeking, and risk-taking, but also demonstrates the fundamental importance of person-environment interactions which underlie the development of risk perception, attitude development, and behaviour. Interpreted with respect to the analyses in this thesis, I suggest that environmental sensitivities and related cultural orientations likely confound the relationship between OSS and CAS. Furthermore, these biological pathways clearly demonstrate how social and interpersonal factors have the potential to become incorporated into individuals – shaping (either through cognition or compulsion) their attitudes, preferences, beliefs, and ultimately, their behaviour.

6.3.4. Cognition

In considering the role of biology, particularly with respect to its effect on behaviour, we should also note that genetic predictors of behaviour generally have a small overall effect size – often estimated around 10% at most. In other words, genetic research supports the heritability (i.e., genetic influence), but not the inheritability (i.e., genetic determinism), of behaviour (McGue & Bouchard, 1998). This distinction helps to articulate how it is that biologic or psychological events alone are insufficient to describe behaviour. Rather, behaviour is the product of complex interactions between biological and psychological beings and their complex environments – whether social or ecological.

Neural cognitive research supports this assertion by showing that virtually every process of higher order cognition – including self-control (Fuentes et al., 2012), collectivism (Chiao et al., 2009; Harada, Li, & Chiao, 2010b), prosocial behaviour (Majdandžić, Amashaufer, Hummer, Windischberger, & Lamm, 2016; Waytz, Zaki, & Mitchell, 2012), and sensation seeking (Zheng et al., 2017) – are highly influenced by the functions of the prefrontal cortex, which itself is a region of the brain that has evolved to free us from biological determinism (Cozolino, 2006; Dunbar, 1998; Semendeferi, Lu, Schenker, & Damasio, 2002) by allowing social and environmental stimuli to shape the very part of the brain that exercises top-down executive function over the sub-cortical regions responsible for memory, error detection, risk perception, and reward processing (Amodio & Frith, 2006; Barbey, Krueger, & Grafman, 2009; Holland & Bouton, 1999; Ito & Lee, 2016; Schoenbaum, Roesch, & Stalnaker, 2006). Given these processes, the biological function of the brain is vital to shaping the psychological dispositions of individuals – including the attitudes and beliefs that shape their behavior.

6.3.5. Reasoned action

Stemming from cognition and acculturation, biopsychosocial processes give rise to distinct attitudes and beliefs regarding behaviour. In Chapter 2, we highlighted how behavioural, normative, and control beliefs were fundamental to what we will describe here as “reasoned action.” For our purposes, this is not distinct from already established theory on the subject: individuals engage in behaviour that they want to, are comfortable with, and are capable of engaging in (Fishbein & Ajzen, 2009) – albeit with the caveat

that these subjectivities are not independent of the social and biological factors which shape them.

6.3.6. Conditioning

One of two final concepts included in my biopsychosocial model of behaviour is that no behaviour is independent of those which have proceeded it. This is in line with the basic concepts developed by behaviorists such as Thondike (1932), Pavlov (1927), Watson (1920) and Skinner (1938), who convincingly demonstrated that behavior could be elicited as a product of external stimuli: When a dog hears the dinner bell, he comes for dinner. When a parent hears a child's cry, they come to rescue. When a child hears his mother's song, he is lulled to sleep. When a bird sees the word peck, it pecks. By the early 1950's, this sort of experience-based learning had come to explain a myriad of complex human phenomenon like emotion, speech (Burrhus Frederic Skinner, 1957), and even free will (Burrhus Frederic Skinner, 2002). While I support the general assertion that behaviour can be conditioned through a process of external and internal rewards and punishments, this should not be interpreted as a full endorsement of behaviourist methodology or rationality. As Chomsky (1959) states, "one would naturally expect that prediction of the behavior of a complex organism (or machine) would require, in addition to information about external stimulation, knowledge of the internal structure of the organism, the ways in which it processes input information and organizes its own behavior." Therefore, when weighing the effects of conditioning, I find myself in agreement with Bandura (1971), who argued that "although behavior can be shaped into new patterns to some extent by rewarding and punishing consequences, learning would be exceedingly laborious and hazardous if it proceeded solely on this basis" (p. 5).

6.3.7. Social selection

Contributing a final piece to my theoretical framework, I also want to acknowledge that social environments do not necessarily shape behaviour without the consent of individuals. Indeed, while certainly much of our culture is transmitted by subversive and hidden means (Bourdieu, 1989; Foucault, 2012), individuals are still capable of seeking out new relationships or escaping them all together. Whether online or offline, whether kinship (family) or kindred (friends), whether 'true' or fictive, the fundamental characteristic of community is people interacting, influencing one another, and choosing

who to be influenced by. Yes, community, from this perspective, is partially about place and partially about form, but its true character is rooted in the social bonds between individuals. To believe that individuals are not active participants in the processes of acculturation would be naive. Indeed, as pointed out by Schneider, the concept of families of choice (i.e. fictive kin) makes for patterns of social transmission that are far too complex to describe here (Schneider, 1984). Suffice it to say, that this process adds just another layer of complexity to those which underlie patterns of cultural reproduction, or as is the case here, cultural adaptation.

6.4. Contributions and Implications

As illustrated by the model I have laid out in the last several pages, as well as in each of the other chapters in this thesis, continued emphasis on the interdependence of biological, psychological, and social-anthropological phenomena is vital for future behavioural research – especially considering our growing capacity to identify the genetic and physiological pre-cursors of behaviour. Common short-sightedness might convince us that only biomedical or psychological therapies have the potential to impact behaviourally defined diseases and epidemics. Contravening this logic, the present thesis demonstrates the need for researchers to better understand the underlying dispositions, orientations, and narratives that shape individuals' attitudes toward health promotion and disease prevention. This is true for both online environments, where public health and community leaders must compete for the attention of GBM, and in offline environments, where their reach is increasingly limited. Indeed, in addition to overcoming the practical challenges of health promotion and diffusion, public health responses to CAS and OSS must address (or at very least consider) the specific pathways – such as the cultural reproduction of collectivism, individualism, and altruism – that underlie these inherently social phenomena. Overly narrow foci on specific patterns of behaviour that do not take into account broader psychosocial conditions cannot be recommended, based on the results of the empirical analyses conducted here.

Instead, this thesis demonstrates the potential utility of programs which promote altruistic behaviour, social inclusivity, and collectivism. While such approaches might be targeted to specific online and offline venues, public health and community leaders should acknowledge that GBM communities are not homogenous with respect to the attitudes

and dispositions exhibited by their constituent members. For example, this thesis – particularly with results from Chapters 4 – shows that even in the context of online-initiated relationships, collectivistic and altruistic orientations provide support for sexual norms amenable to safer sex practices – even though OSS is itself associated with increased sensation seeking and reduced altruism. Prevention efforts which leverage these normative social influences thereby provide public health and community leaders with an already influential strategy for preventing disease transmission. However, these norms cannot be taken for granted. Rather, their influence is contingent on the structural resources available to communities seeking to promote collectivism and interpersonal bonding. Accordingly, the funding of community-based organizations must not be solely contingent on health-related key indicators, but must also consider the broader, and sometimes immeasurable, cultural impact that these groups have. This is especially important for organizations which cater to those living with HIV and are thus often handed the responsibility to prevent HIV transmission.

With that said, online interventions must also take special care to develop messaging that is amenable to the cultural characteristics and narratives of those frequenting online venues – with careful consideration to the higher levels of sensation seeking associated with these environments. For example, sex-positive media campaigns which focus on personal pleasure, enjoyment, and health might be particularly well-received in these venues (Wohlfeiler et al., 2013). Indeed, I have shown – with the results of Chapter 5 – that key psychosocial phenomena underlie the risks associated with online environments. Given the pathways I've identified, I argue that efforts to provide risk-neutral coping strategies for individuals with high sensation seeking are needed. This is particularly important given that sensation seeking has been identified as resistant to traditional behavioural interventions (Zuckerman, 2014). However, considering the role of the DRD4 gene in sensation seeking and the related evidence around environmental sensitivities and stress, future research may find potential avenues for risk-reduction by addressing structural barriers which minimize the negative stress environments of children (who exhibit greater neural plasticity) (Bornovalova, Gwadz, Kahler, Aklin, & Lejuez, 2008; Norbury & Husain, 2015; J. M. Ross, Duperrouzel, Vega, & Gonzalez, 2016). Among adults, interventions might include those which provide alternative outlets for emotional arousal (e.g., social support) among those engaging in high-risk activities; as well as biomedical strategies, such as Pre-exposure prophylaxis, which likely have

significant appeal given their novelty and allowance for pleasure-seeking sexual behaviour (Card et al., 2016; Mosley et al., 2018).

6.5. Strengths and Limitations

The present thesis offers several noteworthy strengths. First, the use of respondent-driven sampling as opposed to venue-based sampling allowed for the recruitment of a sample that is less biased towards specific patterns of community connectedness. This strength persists even after considering that RDS adjustments could not be implemented in all analyses. Second, the use of data-driven analytic strategies (e.g., logistic regression, latent class analysis, principal component analysis, hierarchical event-level logistic regression, and structural equation modelling) provides this thesis with several robust methods to describe the key phenomena of interest and reduce the influence of subjective biases.

However, readers should be cautious when interpreting the results of this thesis. For instance, though I examined a broad array of gay community activities, I did not examine the frequency of GBM's participation at these venues. This was partially due to difficulties in objectively evaluating the meaning and significance of time-scales (i.e., never, less than monthly, about once per month, more than monthly) used to measure these variables. Furthermore, while frequency of participation is undoubtedly important, this thesis was primarily interested in exploring the mediating effects of community connectedness on the widely documented association between dichotomized factors of OSS and CAS. For similar reasons, several of the analysis included here also collapsed across apps and websites to create a variable that measured OSS. While there are likely important differences between these platforms, collapsing them was deemed appropriate due to the use of a collapsed variable in the event-level questionnaire and the shifting equilibrium between website and app use during data collection. Likewise, as specific apps and websites have distinct "cultures" associated with them, my results are not necessarily generalizable to every online platform (Albury, Burgess, Light, Race, & Wilken, 2017; Roth, 2014, 2016). I should also note that in several of the previous chapters "condomless anal sex" was used as the primary outcome factor. While some have argued that CAS is no longer an adequate proxy for HIV risk (Jin et al., 2015), its long history as a focus for HIV prevention makes it a suitable candidate for examining the influence of prevention-related social norms. Furthermore, despite GBM's best

intentions to reduce their HIV risk by sero- and viral-load sorting, these HIV-specific strategies rely on GBM's ability to accurately report their sero-/viral-load status – an assumption that has yet to be validated at the population level (van den Boom et al., 2014). With that said, the meaning of "risk" is rapidly changing given the emergence of effective biomedical prevention strategies, such as PrEP. Given these rapid changes, public health leaders should find ways to empower GBM as they navigate these changing risk environments. Such interventions may include health literacy campaigns to help GBM understand what kinds of CAS pose a risk for HIV-transmission and what kinds are safe (e.g., CAS with partners who have undetectable viral loads. Next, the use of RDS has some limitations on its own. Indeed, preferential recruitment and bias along successful RDS-recruiters has the potential to violate the "random walk" assumption of marched chain modelling – meaning that instead of escaping the original bias of recruited seeds, bias towards specific social covariates may have been repeatedly biased by the recruitment process (Crawford, Aronow, Zeng, & Li, 2017; Forrest et al., 2016). Finally, this thesis has reviewed only a small subset of the indicators which might relate to the social and community connectedness of GBM. Future studies should consider examining a broader spectrum of relationship types, forms of community connectedness, psychologies of belonging, and patterns of social acculturation.

6.6. Conclusion

In conclusion, this thesis finds that sociocultural and interpersonal factors play an important role in shaping the sexual risks associated with online environments. Specifically, I have demonstrated that classic psychosocial factors such as collectivism, altruism, and sensation seeking partially confound the association between OSS and CAS. Furthermore, within the context of online-initiated relationships, prosocial factors also have a protective effect against CAS. Future research should aim to examine these factors with greater attention to their upstream and downstream correlates with the goal of assessing how they can best be leveraged for the development and reinforcement of sexual norms that are consistent with safe-sex (whatever that might mean for a given outcome) and risk reduction practices. Meanwhile, venue-tailored interventions should be careful to develop messaging that is sensitive to existing sociocultural norms and narratives recognizing that current patterns of risk reduction and sexual behaviour are consistently correlated with these factors.

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