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

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Abstract

This study examined patterns of connectedness among 774 sexually-active gay, bisexual, and other men who have sex with men (GBM), aged ≥16 years, recruited using respondent-driven sampling in Metro Vancouver. 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).

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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.

INTRODUCTION

Background

Beginning in the early 1980's, the HIV epidemic swept through gay communities. In response, community action campaigns focused on promoting safe sex to prevent HIV transmission within gay communities [1]. By the mid-1990's, however, highly active antiretroviral therapies (HAART) led to significant declines in HIV-related morbidity, mortality, and transmission [2], fundamentally reshaping the epidemic and its consequences for people living with HIV [3]. 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; [4], leading some to believe that treatment optimism was contributing to greater HIV risk in this population [5]. 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 important social and sex seeking venues for GBM and researchers have demonstrated that apps and websites have had a profound impact on the gay community [6]. Comparisons between online and offline samples and other approaches assessing internet use among GBM show that online samples are younger [7], less likely to identify as gay [8], and exhibit lower community attachment and social embeddedness [8–11], suggesting important differences between GBM connected online and those who are not. Further, online sex seeking has been associated with having more sexual partners [12–16], differing patterns of HIV risk management [17–19], and higher odds of condomless anal sex [20–22]. With the arrival of sex seeking apps in 2009, these trends continue to merit significant attention from health researchers [23–25].

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 [26]. 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) [23,27–31]. 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 [10]. Similar associations have also been documented when exploring so called "scenes" as "micro-cultures" [32]. With respect to these scenes, we also note that not all internet-mediated locales are the same: not only can distinctions be drawn

between websites and apps as such, but even within these two domains there is a significant amount of variation [24,25].

Theoretical Framework

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 [33] 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 [34], applied to sexuality, suggests that sexual behavior can be predicted by one's (i) behavioral beliefs, (ii) normative beliefs, (iii) control beliefs, and (iv) actual controls over one's behavior. Together, these behavioral 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 [35]. 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 [36]. 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 [37], 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 [38,39]—though they were considered earlier by others [40]. 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 [41,42] and a tendency to only embrace technology on the proviso that it is compatible with group norms [43]. Dake further distinguishes between egalitarian and hierarchical collectivists [44], suggesting that egalitarian collectivists tend to perceive new technologies as threats to their social structure [45,46], while hierarchical collectivists are more likely to perceive them as tools by which thy can expand their social dominance [44].

In a similar fashion, culture also appears to shape sexual behavior. 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 behavior [47]. 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 [48]. 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 behavior [49–51]. Our own research on the covariates of sexual risk among GBM shows that collectivism and altruism act as protective factors for online-initiated sexual events [52]. Complicating this picture, Douglas and Calvez [40] 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—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 [53]. As such, gay neighborhoods, complete with gay bars, clubs, bookstores, publications, and many other amenities, have become a common feature of major urban centers [54]. However, the internet and other socio-economic forces have attracted GBM to other neighborhoods [55], decreasing the centrality of these in-person venues in the lives of GBM [56]. Further, theories of social behavior suggest that individuals seek out forms of social participation that are consistent with their social and cultural values [57,58]—creating so called 'micro-cultures,' or what are colloquially referred to as 'scenes' [32].

Objective

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 behavior. 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 behavior.

METHODS

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 6 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 6 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 [59–62]. Upon receipt of informed consent, bio-behavioral 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 [61]. 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.

Independent Variables

Independent variables included participant demographics, prevention-related behavior, 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 behavior 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) [63]. 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%; [64]. 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 [5].

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), for 6 items assessing perceptions of HIV/AIDS stigma in the gay community (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 [65].

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 [51].

A scale measuring collectivist attitudes towards the gay community (herein referred to as collectivism; study α = 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 gay 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. We 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" [66]. As such, this is the approach we have taken in constructing the present scale.

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 behavior, the present study explored patterns of connectedness using a

person-centered analytic approach known as latent class analysis (LCA; [67]). This approach is a subtype 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 behavioral phenomena [67].

Statistical 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 team (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 (≥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 1). 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 2). 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 our analytic approach, statistics were not adjusted using RDS weights.

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 univariate 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. Univariate 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.

RESULTS

Sample Description

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 municipality (n = 240, 31.0%).

The sample also 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.

Latent Class Analysis

Table 1 provides an overview of the selected LCA model, showing the response item probabilities for each latent class (see also: Figure 2). 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, which was characterized by moderately high in-person connectedness and low internet-based connectedness. These individuals are described as “Traditionalists.” Finally, class 3, which comprised 35.4% of the sample, is described as “Techies” due to relatively lower in-person connectedness but high internet-based connectedness.

Figure 3 illustrates recruitment of the sample across time, grouped by LCA class membership, and represents the potential bias that recruitment time may have had on the observed latent class structure. The median date of recruitment for “Socialites,” “Traditionalists” and “Techies,” were respectively: April 9th, 2013 (Q_1, Q_3: September 19th, 2012 – September 11th, 2013), April 25th, 2013 (Q_1, Q_3: October 23rd, 2012 – September 7th, 2013), and May 21st, 2013 (Q_1, Q_3: January 8th, 2013 – October 8th, 2013). These data suggest that “Techies” were on average, recruited significantly later than “Socialites” ($p = 0.011$) or “Traditionalists” ($p = 0.002$), though there was no significant difference between “Traditionalists” and “Socialites” ($p= 0.145$).

Multinomial Logistic Regression

Table 2 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 gay 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 3 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 4 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.

DISCUSSION

In the present analysis, we sought to examine how collectivist attitudes (i.e., collectivism, altruism), risk perceptions (e.g., HAART optimism, HIV/AIDS stigma, TasP awareness), and behavior (i.e., HIV/STI testing history, prevention strategies, serosorting) loaded onto nuanced patterns of social and community connectedness among GBM. In doing so, we used latent class analysis to characterize GBM's patterns of online and offline attachment to the gay community. 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 behaviors, altruistic motivations for safe sex, 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 [33,43,44,46] — 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 [42] and online shopping [41,68].

Of course, patterns of connectedness (as operationalized in the present analysis) are predicted by more than just cultural dispositions. We 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 [69]. 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 [70,71].

Connecting these patterns of connectedness and their relationship with HIV risk management, our findings offer several relevant implications. For example, our 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 [72]. Alternatively, these findings may highlight the role of the internet in promoting HIV stigma among GBM [73]. 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 [17,73].

However, comparing the behavior of Techies and Traditionalists, our findings also suggests that Techies may be more willing to engage in higher risk behaviors (i.e. serosorting for CAS, more sexual partners). Considering this within the context of lower collectivism scores, we note that previous research has shown that individualism has been associated with both the uptake of the internet [42,43,74] and more adventurous sexual norms [40,47]. 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 unproven, entrepreneurial HIV prevention strategies which strike a new balance between risk and pleasure. Again, previous research has shown that greater individualism is associated with the uptake of novel risk prevention strategies [40]. These observed interrelationships between collectivism, connectedness, and risk behavior may lend indirect support to [40] cultural theory of HIV risk among GBM, which aims to describe the role of social and cultural factors in shaping risk perceptions and behavior among GBM [44,75]. However, our findings suggest that the patterns of community connectedness we 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 behavior (i.e., CAS

with serodiscordant or unknown status partners); and less indicative of patterns of sexual behaviors (i.e., seroadaptation). In fact, apart from a few key behaviors (i.e., serodiscordant sex, number of partners), sexual behavior did not vary according to patterns of social connectedness—at least as operationalized in the present study. This may suggest that sexual practices in the gay community are amenable to a variety of cultural orientations (i.e., the socially constructed inclinations of individuals towards specific ways of thought, behavior, or emotion) or modes of community participation.

In light of research by Rodger et al [76], 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 safe sex [77]; 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 behaviors. 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.

LIMITATIONS

Although the present study provides insight into the social and sexual behavior 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 our sample is analogous to other non-adjusted chain-referral samples—where recruitment conditions may influence salient factors considered in our analysis. As such, we 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 our sample [60]. Further, with the emergence of apps in 2009, it is likely that the use of apps and websites by GBM was not in a state of equilibrium across our recruitment period (i.e., February 2012 – February 2015). Therefore, it is possible that individuals recruited earlier in our study were less likely to use apps than those recruited later in our study, simply as a mechanism of when they were recruited into our study. Alternatively, our recruitment of online seeds later in the study period may have also biased GBM recruited later in the study towards increased app use [59]. 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 app and website use 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 [78], the present study may underestimate app or website use among for these individuals. Third, although patterns of connectedness were correlated with our measures assessing

collectivism, LCA classes did not directly measure the cultural orientations hypothesized by Douglas [79]. Although latent classes might indirectly measure elements of culture, acting as potential signals supporting the importance of cultural biases, our findings 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 [32]. The associations presented here may therefore average over participant characteristics, obscuring important and relevant findings. This is particularly true when considering our 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 behaviors these GBM employ.

CONCLUSIONS

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). Further, acknowledging previous literature drawing an association between collectivism and risk perception [40,44,47], 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 behavior. Meanwhile, we 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.

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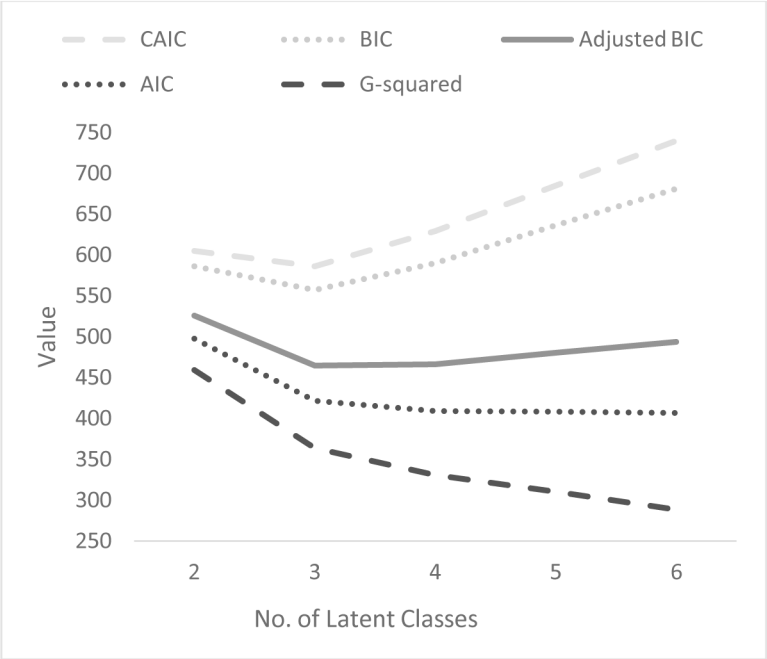

Figure 1. Fit Statistics Considered in the Selection of LCA Models

AIC = Akaike information criterion, BIC = Bayesian information criterion, CAIC = Consistent Akaike information criterion, G-squared = Maximum Likelihood Test (G-Test) Statistic

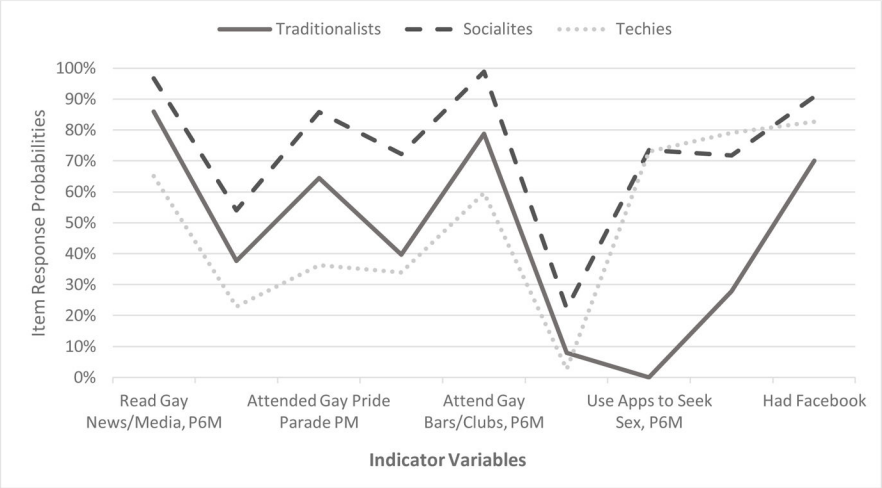

Figure 2.
Item response probabilities for each LCA class

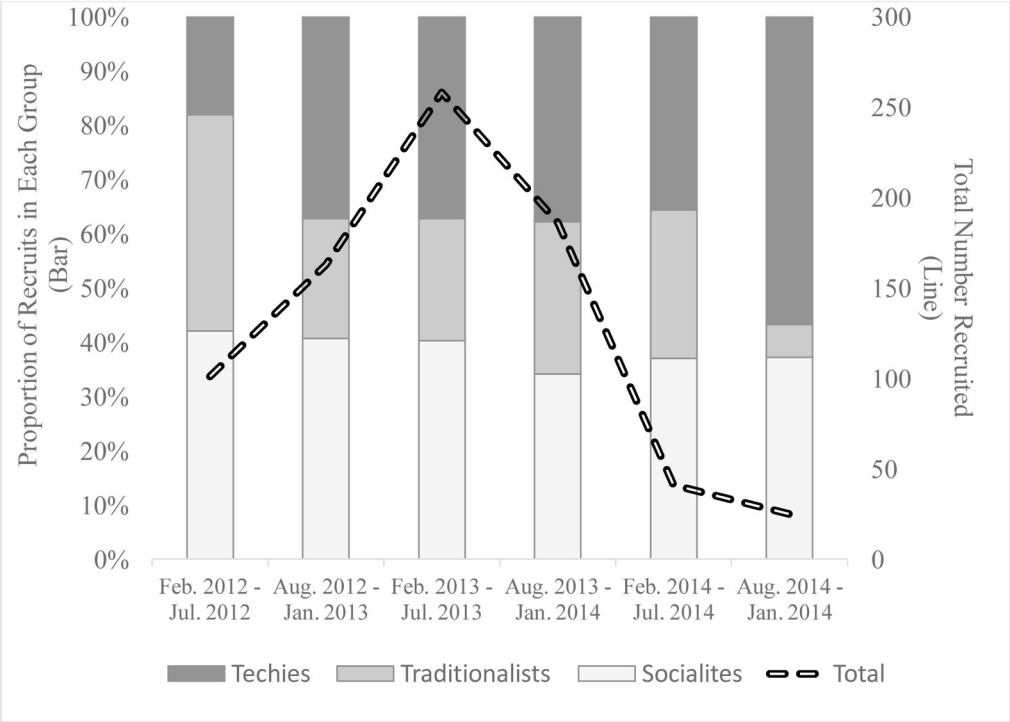

Figure 3.
Temporal Recruitment of Participants, by Latent Class

Table 1

Results of Latent Class Analysis

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: Bolded Text = conditional probability ≥ 0.5; P6M = Past 6 Months; P12M = Past Year

Table 2

Demographic and Social Characteristics of Latent Classes

	Class 1: Socialites	Class 2: Traditionalists	Class 3: Techies	Univariate 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**
Gay Identity						
Gay	87.4	80.2	84.7	Ref	Ref	Ref
Other	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

	Class 1: Socialites	Class 2: Traditionalists	Class 3: Techies	Univariate Comparisons		
				1 vs. 2	1 vs. 3	2 vs. 3
	%	%	%	*p*	*p*	*p*
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	*9 (7, 10)*	8 (6, 9)	7 (5, 8)	0.079	**0.018**	0.716
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 univariate multinomial logistic regression at $p < 0.05$; OR = Odds Ratio; CI = Confidence Interval; PM = Past Month

Table 3

Health-Related Characteristics of Latent Classes

	Class 1:	Class 2:	Class 3:	Univariate 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, Past 2 Years	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)*						

	Class 1:	Class 2:	Class 3:	Univariate Comparisons		
	Socialites	Traditionalists	Techies	1 vs. 2	1 vs. 2	1 vs. 2
	%	%	%	*p*	*p*	*p*
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**
Serodiscordant/unknown CAS, P6M	38.1	29.5	45.6	0.050	0.073	**0.001**
# Male Sex Partners, P6M	*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 univariate multinomial logistic regression at $p < 0.05$; OR = Odds Ratio; CI = Confidence Interval; P6M = Past 6 Months; P12M = Past 12 Months

Table 4

Multivariable Multinomial Logistic Regression Results

	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)	**0.43 (0.28–0.66)**	**0.59 (0.41–0.86)**	1.38 (0.89–2.15)
Current Relationship			
Monogamous/Married	Ref	Ref	Ref
(Partially) Open	0.67 (0.37–1.22)	1.12 (0.60–2.07)	1.67 (0.88–3.19)
No Regular Partner	**0.54 (0.32–0.91)**	1.45 (0.85–2.47)	**2.70 (1.54–4.74)**
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)**	1.00 (0.94–1.06)	1.07 (1.00–1.15)
HIV Tested, Ever	**0.37 (0.17–0.84)**	1.23 (0.52–2.91)	**3.30 (1.43–7.63)**
Ask Partners their HIV Status	**0.57 (0.38–0.85)**	1.03 (0.71–1.48)	**1.80 (1.20–2.70)**
CAS with serodiscordant/unknown status partner, P6M	0.74 (0.48–1.14)	1.32 (0.91–1.92)	**1.79 (1.16–2.70)**
# Male Sex Partners, P6M	**0.99 (0.98–1.00)**	1.00 (1.00–1.00)	**1.01 (1.00–1.02)**
Recruitment Time (odds per month)	0.98 (0.96, 1.01)	**1.03 (1.00, 1.05)**	**1.05 (1.02, 1.08)**

Bold indicates $p < 0.05$; CBO = Community Based Organization; P6M = Past 6 Months; aOR = Adjusted Odds Ratio; CI = Confidence Interval