The Multiplex Social Environments of Young Black Men Who Have Sex with Men: How Online and Offline Social Structures Impact HIV Prevention and Sex Behavior Engagement

Lindsay E. Young\textsuperscript{a,b,f}, Kayo Fujimoto\textsuperscript{e}, Leigh Alon\textsuperscript{a,b}, Liang Zhang\textsuperscript{d}, and John A. Schneider\textsuperscript{a,b,c}

Abstract

In the United States, young Black men who have sex with men (YBMSM) remain disproportionately affected by HIV. The social networks in which YBMSM are embedded are generally understood to be critical factors in understanding their vulnerability. In this study, we acknowledge the relational richness of YBMSMs’ social environments (what we define as multiplexity) and their increasing prioritization of online social networking sites (SNS). Specifically, we investigate whether protective and/or risky features of YBMSMs’ Facebook friendships and group affiliations are related to their HIV prevention and sex behavior engagement, while also accounting for features of their offline confidant (or support) and sex networks. Using data from a population-based cohort study of YBMSM living in Chicago (N=268), we perform a series of multiple logistic regression analyses to examine associations between features of YBMSMs’ Facebook, confidant, and sexual networks with three prevention outcomes and three sex behavior outcomes, while also controlling for factors at the individual and structural levels. Results show that network features play a more significant role in predicting engagement in sex behaviors than prevention behaviors. Specifically, having more confidants, having confidants who are family members, meeting sex partners online, having more YBMSM Facebook friends, belonging to Facebook groups with an LGBTQ focus, and having greater subject diversity in one’s Facebook group affiliations were significantly
associated with one or more sex behavior outcomes. We conclude with a discussion of the implications of our findings for HIV prevention intervention efforts.

---

aChicago Center for HIV Elimination, University of Chicago, Chicago, IL, USA
bDepartment of Medicine, University of Chicago, Chicago, IL, USA
cDepartment of Public Health Sciences, University of Chicago, Chicago, IL, USA
dHarris School of Public Policy, University of Chicago, Chicago, IL, USA
eCenter for Health Promotion and Prevention Research, School of Public Health, University of Texas Health Science Center at Houston, Houston, TX, USA
fCorresponding author: Lindsay Young, University of Chicago, Department of Medicine, Section of Infectious Disease, 5837 S. Maryland Ave., Chicago IL 60637; Email: lyoung1@medicine.bsd.uchicago.edu.
Introduction

Despite salient strides in HIV elimination efforts in the United States, some populations, most notably young men who have sex with men (YMSM), remain disproportionately affected (CDC, 2014b). Among them, young Black MSM (YBMSM) bear the heaviest burden of new HIV infections, accounting for more than any other subgroup by race/ethnicity, age and sex (CDC, 2016). Reasons for these race and age-based disparities are varied and not well understood, especially as YBMSM tend to demonstrate lower levels of many of the factors generally assumed to be related to HIV risk, such as number of sex partners, engagement in condomless sex, and frequency of HIV testing (Millett, Flores, Peterson, & Bakeman, 2007).

More recently, the social networks of young racial/ethnic and sexual minorities have been positioned as critical factors in understanding their HIV vulnerability (Fujimoto, Flash, Kuhns, Kim, & Schneider, 2018; Fujimoto, Williams, & Ross, 2013; Millett et al., 2007). This socio-environmental perspective stresses that both prevention and risk behaviors, like getting tested for HIV or engaging in condomless sex, are often incubated in networked milieus through processes of peer influence (J. A. Kelly et al., 1991), social norms (Latkin, Forman, Knowlton, & Sherman, 2003), and structural embeddedness (Schneider, Michaels, & Bouris, 2012; Shah et al., 2014).

For most young adults, online social-networking sites (SNS) — i.e., the Internet-based platforms that enable connection and communication between users (Holloway et al., 2014) — are increasingly salient features of their social lives (Greenwood, Perrin, & Duggan, 2016). Although the exact number of MSM who use SNS is difficult to assess (Liau, Millett, & Marks, 2006), it is known that about 90% of young adults are engaged with SNS (Perrin, 2015) and that LGBT young adults use SNS more than their heterosexual counterparts (Harris, 2008; Taylor, 2013).

As young adults spend increasing amounts of time online, a new wave of digital public health research has been ushered in (Capurro et al., 2014; Yonker, Zan, Scirica, Jethwani, & Kinane, 2015) that draws on SNS as explanatory mechanisms of heath behavior engagement (Holloway et al., 2014; Rice, Holloway, et al., 2012; S. D. Young, Szekeres, & Coates, 2013). However, in HIV prevention research, the almost singular focus on popular online dating sites for MSM (e.g., Grindr) (Goedel & Duncan, 2015; Landovitz et al., 2013; Rice, Holloway, et al., 2012; Winetrobe, Rice, Bauermeister, Petering, & Holloway, 2014) have come at the cost of understanding how broader socializing behaviors on other commonly used SNS (e.g., Facebook, Instagram, Snapchat) are related to their HIV prevention and risk engagement. Furthermore, little attention has been paid to understanding how SNS networks factor into a larger and richer suite of online and offline relationships theorized to be associated with critical HIV-related behaviors. We refer to the richness of an individual’s social environment as its multiplexity. By granting attention to our definition of multiplexity from the socio-environmental perspective, it becomes possible to see how a more comprehensive system of co-existing and often overlapping social contexts are associated with an individual’s HIV prevention and risk engagement.

In this study, we acknowledge the multiplexity of YBMSMs’ networks (i.e., the multiple contexts in which YBMSM interact with one another) and their increasing prioritization of online social networking contexts that extend beyond the narrow realm of dating applications.
Specifically, we investigate the degree to which features of YBMSMs’ personal Facebook networks — still the most popular social media platform used by young adults (Greenwood et al., 2016) and most ubiquitously used among the YBMSM in this study — are related to their HIV prevention and sex behaviors, while also accounting for the effects of their self-reported sex and confidant (i.e., social support) networks. Using multiple logistic regressions, we examine the effects of structural and compositional features of distinct Facebook, sex, and confidant networks that we regard as constituting YBMSMs’ multiplex network environments on three prevention outcomes and three sex behavior outcomes. Our statistical models control for individual and structural factors known to be related to HIV prevention engagement and HIV-related sex behaviors. The results presented will sharpen our understanding of which network contexts contribute most to prevention and sex behavior engagement and will provide insights on which aspects of YBMSMs’ multiplex network environments offer opportunities for intervention.

**Social Networks and HIV Prevention and Risk Behaviors**

Interest in contextual factors related to HIV has grown considerably in recent years and has yielded research that enables a better understanding of the network mechanisms of HIV prevention and risk (Fujimoto et al., 2018; Kuhns, Hotton, Schneider, Garofalo, & Fujimoto, 2017; L. E. Young, Fujimoto, & Schneider, 2018). Epidemiological studies tend to highlight how sexual contact networks function as engines of viral transmission (Friedman et al., 1997; Parker, Ward, & Day, 1998; Périsse & Nery, 2007) through network features like partner concurrency (Morris & Kretzschmar, 1995), network position (Fichtenberg et al., 2009), personal network density (Doherty, Schoenbach, & Adimora, 2009), and assortative mixing (Adimora, Schoenbach, & Doherty, 2006; Schneider et al., 2013). Meanwhile, socio-behavioral research tends to not only emphasize the way in which social networks function as transmitters of information and influence (J. A. Kelly et al., 1997; Latkin, Sherman, & Knowlton, 2003), but also as progenitors of social norms, like needle sharing practices (Lakon, Ennett, & Norton, 2006; Latkin, Forman, et al., 2003), condom use (Barrington et al., 2009; Yang, Latkin, Luan, & Nelson, 2010), and exchange sex (Latkin, Hua, & Forman, 2003), and as sources of instrumental and emotional support, which have been linked to utilization of health care services and medical adherence among people living with HIV (Gardenier, Andrews, Thomas, Bookhardt-Murray, & Fitzpatrick, 2010; Tobin & Latkin, 2017).

As YMSM increasingly turn to the Internet to seek community and interact with peers, interest in understanding the link between HIV risk and online social networks has mounted. To date, much of this work adopts a behavioral surveillance approach, focusing on MSM who use online dating applications (e.g., Grindr) and the role these platforms play in structuring their sexual contact networks. Results of this research are mixed thus far, with some studies revealing positive associations between online partner-seeking and sexual risk behaviors (Garofalo, Herrick, Mustanski, & Donenberg, 2007; Horvath, Bowen, & Williams, 2006; Landovitz et al., 2013), others finding no association (Chiasson et al., 2007; Grosskopf, LeVasseur, & Glaser, 2014; Mustanski, Lyons, & Garcia, 2011), and still others identifying positive associations with protective behaviors (Rice, Holloway, et al., 2012).

Alternatively, other studies (Black, Schmiege, & Bull, 2013; Buhi et al., 2013; Moreno, Parks, Zimmerman, Brito, & Christakis, 2009; Whiteley et al., 2011; S. D. Young et al., 2013) have
directed attention to the risk and protective potentials of more general purpose SNS like Facebook, where the user base is broader and the content more diverse. Although some of this work has maintained an emphasis on partner-seeking behaviors in these networks (Buhi et al., 2013), others have moved beyond this paradigm. For decades, social influence research has underscored the role of formal and informal peer groups — such as friendships, schoolmates, and peers who meet at entertainment venues such as bars — for norm formation and informal social control, which are known mechanisms of HIV risk- and prevention-oriented behaviors (Friedman et al., 2013; Fujimoto, Wang, Ross, & Williams, 2015; Schneider et al., 2013). Peer groups are best able to exert influence on an individual’s HIV-related behaviors through routine and reinforced communication and when an individual feels some degree of affinity and/or similarity with other members of their peer group (Lapinski & Rimal, 2005).

By extension, digital peer networks like those on Facebook are generally assumed to exert the same normative influences (Boyd & Ellison, 2007; Traud, Mucha, & Porter, 2012). For example, studies of adolescent SNS users have demonstrated that the topics adolescents discuss with their peers and the photos they share are important predictors of their actual HIV risk and protective behaviors (S. D. Young & Rice, 2011), as well as their perceptions of behavioral norms (S. D. Young & Jordan, 2013). Still, others have investigated network signatures of emerging behavioral norms by focusing on relational clusters of sexual risk behavior in SNS peer networks. For example, Moreno, Brockman, Rogers, and Christakis (2010) showed that adolescents who posted explicit sexual references were more likely to have online friends who did the same, while L. E. Young et al. (2018) reported that YMSM who engaged in condomless sex tended to cluster around a common set of Facebook groups.

What remains to be explored, however, is how normative features of online social networks — like the degree to which YMSM are connected with other MSM and the types of topics they discuss in Facebook groups — impact HIV prevention and sex behavior engagement relative to: (1) features of other, more well-studied sex partner or support networks; and (2) non-network factors that lie at individual and structural levels. To this end, we adopt a social epidemiological perspective (Rhodes et al., 2012) to structure our empirical investigation. From this point of view, the production of HIV prevention and sex behaviors is situated in an interplay of factors that lie at individual, social, and structural levels (Rhodes, Singer, Bourgois, Friedman, & Strathdee, 2005) as shown in Figure 1.

As Figure 1 depicts, the micro environmental level includes the individual-level factors known to impede or facilitate HIV prevention and sex behavior engagement, for example socio-demographics (Mimiaga et al., 2009), sexual identity (Gamarel et al., 2017; Gould, 1967; Harawa et al., 2008; Millett, Malebranche, Mason, & Spikes, 2005), other individual risk and prevention behaviors (Schneider et al., 2013; L. E. Young et al., 2017), and HIV status. Meanwhile, at the macro environmental level are the factors that influence HIV-related behaviors through more distal economic and social structural vulnerabilities, like health insurance coverage (Mimiaga et al., 2009), housing instability (Kipke, Montgomery, Simon, Unger, & Johnson, 1997; Rice, Barman-Adhikari, Milburn, & Monro, 2012; Rice, Milburn, & Rotheram-Borus, 2007), and criminal justice involvement (Brewer et al., 2014; Javanbakht et al., 2009).
Figure 1. Conceptual framework for an environmental perspective on the production of HIV prevention and sex behavior outcomes (adapted from Rhodes, Singer, Bourgois, Friedman, and Strathdee, 2005)

In between individual and structural levels are the meso-level social factors that relate to an individual’s embeddedness in peer networks. From this perspective, the extent to which an individual is at risk for HIV (or protected from it) depends on where they are located within a given network (i.e., network structure/position) and the patterns of behavior, infection, and related characteristics among the other network members to which they are connected (i.e., network composition) (Schneider, 2013). For example, a centrally located individual in a high risk sexual contact network may be at greater risk of viral exposure, while an individual who has close friends who encourage condom use may experience normative pressure to engage in prevention practices.

This study underscores the role of an individual’s network multiplexity. Therefore we include features of an individual’s confidant, sex partner, Facebook friendship and Facebook group affiliation networks. In Figure 2, we exemplify what relational multiplexity looks like at the ego-network level through the lens of a hypothetical ego (or study respondent) and his connections to 12 identified peers and 8 Facebook groups. Dyadic multiplexity — when two individuals interact in more than one relational context — is shown by the presence of multiple ties between ego and a peer. For example, the relationship between ego and peer 10 is the highest level of multiplexity, as they interact as confidants, sex partners, and Facebook friends. Although the analysis featured in this study does not include an explicit measure of dyadic multiplexity as a covariate, the fact that an individual’s personal social environment includes more than one relational context, in which peers can engage, warrants including features of each type of relationship when articulating network contextual models of HIV-related behaviors.
Figure 2. A hypothetical multiplex egocentric network. The egocentric network is comprised of an Ego, or study respondent, (black circle), their identified peers (gold circles), and their identified Facebook groups (pink squares). Three types of co-existing and overlapping relationships are shown between ego and his/her/their peers: (1) confidant ties (lines in red); (2) sex partner ties (lines in green); and (3) Facebook friendship ties (lines in blue). A fourth type of relationship is shown between ego and Facebook groups to show an ego’s Facebook group affiliations (dashed lines). In total, ego has 4 confidants, 3 sex partners, 10 Facebook friends, and 8 Facebook group affiliations. Dyadic multiplexity (when two individuals interact in more than one relational context) is shown by the presence of multiple ties between the ego and a peer.

Methods

Study population

As described in previous work (L. E. Young et al., 2018), data used in this study was collected as part of uConnect (2013-2016), a longitudinal cohort study of YBMSM living in Chicago. The analysis featured here draws from data collected at Wave 2 of the study. This study was approved by the institutional review boards of the University of Chicago and the National Opinion Research Center (NORC) at the University of Chicago and was supported by grants from the National Institute on Drug Abuse (NIDA) and National Institute of Mental Health (NIMH).

Participants were recruited using a variant of classic link-tracing called Respondent Driven Sampling (RDS) (Heckathorn, 1997). Widely used in public health studies (Goel & Salganik, 2010), RDS methodology enables us to recruit “hard to reach” populations (e.g., people who inject drugs, sex workers, men who have sex with men) by providing a sampling design. Additionally, it provides us with an estimation method for obtaining parameter estimates of the target population.
A group of 62 initial RDS “seeds”, drawn from a variety of social spaces that YMSM occupy, including LGBTQ social venues, online networking sites, community-based organizations, and HIV treatment and prevention programs, were used to generate referral chains. Each respondent was given up to six vouchers to recruit others who met the same eligibility criteria. Respondents received $60 for their participation and $20 for each recruit who enrolled into the study. Candidate participants were eligible to be interviewed if they: 1) self-identified as African American or Black; 2) were assigned male at birth; 3) were between 16 and 29 years of age (inclusive); 4) reported oral or anal sex with a male within the past 24 months; and 5) were willing and able to provide informed consent at the time of the study visit. Sampling procedures resulted in a baseline sample of 618 YBMSM, 525 of which were retained at Wave 2 of the study, which is the cross-sectional data used for this analysis.

Data Collection

Respondents completed an interviewer-administered questionnaire, which included modules pertaining to demographics, sexual health and other sex behaviors, and relational information about their personal confidant and sexual networks. The confidant network name generator elicited up to five confidants using the prompt, “Please list the names of the people with whom you discuss things that are important to you.” The sex partner generator elicited information on up to six recent sexual partners since the last study visit (~ 9 months prior). As was done by the National Health, Social Life, and Aging Project (NSHAP) (Cornwell, Schumm, Laumann, Kim, & Kim, 2014) and the National Health and Social Life Survey (Laumann, Gagnon, Michael, & Michaels, 1996), after generating a list of the five most recent sexual partners, a further question was asked about any current primary sexual partner. If the respondent gave the name of a current primary partner who was not among the five partners, they were added to the roster as a sixth alter. Additionally, name interpreters were used to elicit additional information from the respondent about their named confidant and sex partner alters (Schneider et al., 2017), including, but not limited to, details about their demographics, sexual preferences, sex behaviors, and substance use behaviors.

Facebook friendships and group affiliations were obtained from consenting respondents using a third party software application that accessed Facebook’s application programming interface (API) (Khanna, Schumm, & Schneider, 2017). Using the application interface, respondents logged into their primary Facebook account, which then enabled the application to retrieve lists of the respondent’s Facebook friends and Facebook groups. Since this data was collected, Facebook made changes to its API permissions that have subsequently made this method of data collection obsolete. Of the 525 respondents retained at Wave 2 of the study, 423 self-reported having an active Facebook profile, 347 of whom consented to Facebook data collection (L. E. Young et al., 2018). We restricted the Facebook friendship network to include only study participants and the Facebook friendship ties among them, as our primary interest was in learning how SNS connections, specifically among other YBMSM, impact their HIV-related behaviors. As such, results should be interpreted with this caveat in mind.
Characterizing Facebook Groups

The main features of Facebook groups that we explored in this study were their primary subject matter and privacy status, which is the degree to which the group is visible to non-member Facebook users. While the subject matter of a Facebook group is suggestive of the interests of its members and what they talk about in these settings, the privacy status of a group speaks to the degree to which its members (and their identities) are protected from outside scrutiny. Both features are believed to have implications for HIV care and sex behavior engagement (L. E. Young et al., 2018).

To classify groups by their primary subject matter, we drew on two pieces of information – the name of a group and the brief group description provided on its profile page. As not all groups provide a description, those without one were excluded from the analytic sample. The subject categories were derived from a survey of the literature and from an environmental scan of a random sample of Facebook groups in our analytic sample. We used an iterative process of pilot-testing and refining the subject category codebook to ensure adequate capture of subjects represented. In total, nine subject categories were identified and are described in Table 1.

We then trained two student coders to code each Facebook group for its subject based on what they could derive from its name and description. First, they used a multiple choice selection scheme – i.e., identifying all subjects that were applicable to each group. This was followed by a forced choice selection of its primary subject. An inter-coder reliability test was performed on the primary subject coding for the full sample, after which all points of disagreement were resolved through consensus coding. Student coders achieved an inter-coder agreement of 0.86 prior to the consensus coding. Additionally, a senior member of the research team also coded 10% of the Facebook groups, which was followed by a second inter-coder reliability test that compared her coding decisions to the student coders’ consensus decisions. The senior coder achieved an inter-coder agreement of 0.93 with the student coders.

Outcome Measures

Prevention Engagement. Prevention-oriented outcomes included receiving HIV care (prevention or treatment services) from a provider, regular HIV and/or Sexually Transmitted Infection (STI) testing, and awareness of pre-exposure prophylaxis (PrEP) for HIV prevention. Receiving HIV care was measured by asking participants whether they received prevention or treatment services during their last visit to a health service provider. To assess frequency of HIV/STI testing, respondents were asked to indicate how many times they had been tested since their last visit 9 months prior. Given CDC testing recommendations for men who have sex with men and at risk for HIV (every 3-6 months), a dummy variable was created, whereby regular testers were defined as those who had been tested at least twice since their last visit 9 months prior. Awareness of PrEP was ascertained by asking respondents, “Before today, have you heard of PrEP?” No other PrEP-related information was presented to respondents at the time of data collection.

Sex Behaviors. Sex behaviors included measures of a respondent’s engagement in condomless sex, sex drug use, and group sex. Condomless sex was measured on the basis of frequency of
Table 1. Subject Classification Scheme for Facebook Groups

| Subject Category       | Definition                                                                                                                                 |
|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| Sexual Attraction *    | Groups that underscore physical/sexual attractiveness and that enable partner “cruising”, flirtatious exchange, sexual networking, and sexual expression |
| Chat *                 | Groups that provide a casual forum for posting and conversational exchange among members; posts tend not to be subject specific and content tends to be random (e.g., gossip groups) |
| LGBTQ Identity *      | Groups that are about gay pride or gay identity; the focus is on celebrating gay identity and “being” in the LGBTQ community (e.g., LGBTQ advocacy groups) |
| Ballroom Culture *     | Ballroom Houses are queer surrogate kinship groups that take on the role structure of traditional hetero-normative families (e.g., mothers, fathers, children, siblings) and participate in gender expression competitions/performances. These are groups for members of specific Ballroom Houses and Gay Families, groups about Ballroom culture, groups about performance styles (e.g., vogueing) |
| Events                 | Groups that promote events — e.g., nightlife/club events, festivals, community events, live shows, etc.                                    |
| Recreational Interests | Groups about past time interests and hobbies pursued for fun, amusement, or entertainment. Examples include: sports, gaming, dance, poetry, art, reading, listening to music, watching TV etc. |
| Personal / Professional Promotion | Groups that promote an individual’s image and/or talent for that person’s gain; groups that enable professional networking, promote personal businesses and jobs, money-making opportunities, career advancement etc. |
| Health & Well being    | Groups that provide information and/or support to members with respect to physical, emotional, and spiritual health and well being.             |
| Community              | Groups about place-based community life (e.g. school alumni groups, neighborhood alumni groups, church groups, groups about living in Chicago, etc.) |

* Subject categories included in the featured analysis; In the analysis presented here LGBTQ Identity and Ballroom Culture were combined into one subject category (called LGBTQ Identity)

condom use with named anal sex partners in the past 9 months. If the respondent indicated not always using condoms with any of their partners, they were coded as having had condomless sex. Similarly, respondents were asked about their use of drugs to enhance their sexual experience or make sex easier to get. Respondents who indicated having done so with at least one partner were coded as having used sex-drugs. Group sex is a self-reported measure of whether or not a respondent indicated having engaged in sex with two or more partners at the same time at least once in the past 12 months (Schneider et al., 2013).

**Covariate Measures**

**Confidant and sex network features.** A series of compositional features of personal confidant and sex networks were included as possible predictors of HIV prevention and risk outcomes. Compositional features account for the characteristics of the alters in each confidant and sex partner network (Wellman & Frank, 2001) and, by extension, the degree to which the focal individual is exposed to those characteristics. In the confidant network, we focus on three traits that represent aspects of social support and affirmation that can be linked to HIV prevention and care engagement, including the proportion of confidants who play familial roles either as biological family members or as members of a respondent’s chosen gay family (Frost, Meyer, &
Schwartz, 2016; Schneider et al., 2012; Wohl et al., 2011), the proportion of confidants who know that the participant has sex with men (Smith, Rossetto, & Peterson, 2008; Tobin & Latkin, 2017), and the proportion of confidants who also have sex with men (Frost et al., 2016). Compositional measures related to sex partner characteristics include the proportion of partners who are perceived as HIV positive by the respondent and proportions of partners who were met through mutual friends, at physical LGBTQ social venues (e.g., bars, clubs, ballroom events), in public spaces (e.g., parks), and on websites or mobile apps (e.g., Adam4Adam.com, Grindr, Jack’d). We pay attention to where or how individuals meet their partners to account for differential HIV and STI risks associated with various methods for meeting partners (Binson et al., 2001; Grov, Parsons, & Bimbi, 2007; Landovitz et al., 2013; Winetrobe et al., 2014).

**Facebook network features.** In this study, we focus on an individual’s Facebook friendships with other YBMSM study participants and their Facebook group affiliations as two salient dimensions of their online social environment. Regarding Facebook friendships, we investigate the effect of degree centrality, which corresponds here to the number of friendship connections each participant has with other YBMSM study participants. We characterize a personal Facebook group network in terms of size, the presence or absence of each subject category, the number of different subject categories (i.e., compositional range), and privacy. The size of a Facebook group affiliation network was measured as the number of Facebook groups — that included a group description — to which an individual belonged. Dichotomized measures of subject matter include belonging to at least one group that was thematically categorized as LGBTQ Identity, Sexual Attraction, and Chat, each of which were related to primary prevention and risk outcomes in bivariate analyses not shown here. The compositional range of group subjects in a group affiliation network represents the network’s topical diversity and was measured as the number of different types of group subjects (ranging from 1-9) that were represented in an individual’s group membership portfolio. Finally, Facebook groups can be public, closed, or secret, ranked in order of decreasing visibility to non-member Facebook users. Prior work has linked engagement in sexual risk behaviors to a preference for secret groups (L. E. Young et al., 2018). Therefore, we include an indicator variable for this level of privacy.

**Control variables.** In line with the social environmental framework adopted in this study, we also control for individual-level and structural factors known to influence YBMSMs’ engagement in HIV prevention and sex behaviors. Individual level factors include a continuous measure of age (CDC, 2014a), an indicator for bisexual identity (Millett et al., 2005), and an indicator for being HIV positive, measured on the basis of blood testing conducted at the time of data collection. We also include an indicator for being a member of the ballroom house or gay family communities (Arnold & Bailey, 2009) — systems of queer kinship among African American and Latinx LGBTQ people that appropriate heteronormative family like organizational structures (e.g., mothers, fathers, siblings) — which our prior work has shown to be predictive of some types of HIV prevention engagement (Khanna et al., 2016; L. E. Young et al., 2017). Also at this level, we account for recreational use of marijuana (Morgan et al., 2016) and each of the other co-existing HIV prevention and/or sex behaviors not being modeled as the primary outcome. At the structural level, we include binary measures of having health insurance coverage, experiencing homelessness or housing instability, and incarceration history.
**Analysis Procedures**

Data featured in this study comes from Wave 2 of the uConnect study. Of the 525 respondents in Wave 2, 423 self-reported having an active Facebook profile, 351 of whom consented to Facebook data collection. As a key aim of the study was to examine the effects of Facebook network features relative to features of self-reported confidant and sex networks, the analytic sample was restricted to include only those who had at least one Facebook friend and belonged to at least one Facebook group among the 347 participants who consented to the Facebook download. This resulted in a final analytic sample of 268 YBMSM. The filtered cases (n=257) did not differ significantly from the analytic sample (n=268) by any of the prevention or sex behavior outcomes. However, the YBMSM in the analytic sample were more likely to be HIV positive [Odds ratio (OR)=1.72, p<0.05]. Subsumed in the filtered cases are study participants who reported having a Facebook profile, but refused to provide consent to the Facebook data collection (n=72). YBMSM in the analytic sample were more likely to receive HIV prevention and care services [OR=2.14, p<0.005] and to have heard about PrEP [OR=2.28, p<0.003] than the individuals who refused to consent. These differences mean that results should be interpreted with this caveat in mind.

Descriptive statistics (percentage for dichotomous variables and mean and standard deviation for continuous variables) were calculated for all outcomes and covariates. Multivariate logistic regression analyses were performed to examine associations of network features with each prevention and sex behavior outcome, while also controlling for individual and structural factors. Adjusted odds ratios (aORs) and their 95% confidence intervals (95% CIs) were calculated. All models were fit using RDS sampling weights, specifically Gile’s Sequential Sampling (SS) estimator (Gile, 2011; Gile & Handcock, 2010), an extension to the RDS-II estimator developed by Volz and Heckathorn (2008) to handle bias from the sampling-with-replacement assumption. All statistical analyses were performed using STATA 15 statistical software package (StataCorp, 2017).

**Results**

**Characteristics of YBMSM**

Table 2 shows the characteristics of the YBMSM in our analytic sample (N=268).

*HIV prevention and sex behaviors.* With respect to prevention outcomes, majorities of the sample reported receiving HIV prevention and treatment services from a provider (68%), engaging in clinically recommended HIV/STI testing (84%), and being aware of PrEP (77%). Regarding sex behavior outcomes, nearly 60% reported engaging in condomless sex, while 35% and 17% reported engaging in sex drug use and group sex, respectively.

*Confidant and sex network characteristics.* Respondents named, on average, 2.21 confidants (i.e., people they feel they can talk to about important matters). A little less than half of respondents reported that at least one of their confidants (46%) was an MSM, and/or knew the respondent was a MSM (40%). Only 10% reported having at least one confidant who they considered part of their biological or play family. On average, respondents named 2.72 sex
Table 2. Characteristics of young Black men who have sex with men in Chicago, USA (N=268)

| Characteristics                                                                 | Percent  |
|---------------------------------------------------------------------------------|----------|
| **Prevention and sex behaviors**                                                 |          |
| Received HIV care (prevention or treatment) from provider                        | 68.3     |
| Tested for HIV or STIs at least 3 times in the last 9 months                     | 83.6     |
| Heard of PrEP                                                                     | 77.2     |
| Condomless sex                                                                   | 59.3     |
| Sex drug use                                                                     | 35.1     |
| Group sex                                                                        | 17.2     |
| **Sociodemographic, behavioral and structural factors (controls)**               | 23.47 (2.90; 17, 29) |
| Mean Age                                                                         | 23.47 (2.90; 17, 29) |
| Sexual orientation (bisexual)                                                    | 26.1     |
| HIV status (HIV+)                                                                | 41.4     |
| Health insurance coverage                                                        | 77.2     |
| Housing instability (in last 12 months)                                          | 20.5     |
| Criminal justice involvement (ever)                                              | 11.9     |
| Member of a ball house or gay family                                             | 31.3     |
| Recreational marijuana use (daily or more)                                      | 29.5     |
| **Confidant ego-network features**                                              |          |
| Mean number of confidants                                                        | 2.21 (1.11; 0, 5) |
| At least one confidant who is MSM                                                | 45.5     |
| At least one confidant who knows respondent is MSM                              | 39.9     |
| At least one confidant who is biological / play family                          | 10.1     |
| **Sexual ego-network features**                                                 |          |
| Mean number of partners in past 6 months                                         | 2.72 (1.58; 0, 6) |
| At least one partner who is HIV+                                                 | 24.6     |
| At least one partner met through mutual friends                                  | 47.8     |
| At least one partner met at bars, clubs, or ball events                          | 14.9     |
| At least one partner met in public spaces                                       | 20.2     |
| At least one partner met online                                                  | 46.3     |
| **Facebook network features**                                                    |          |
| Number of Facebook friends                                                      | 44.65 (27.60; 0, 162) |
| Number of Facebook group affiliations                                           | 11.00 (14.01; 1, 89) |
| At least one LGBTQ identity Facebook group                                     | 56.4     |
| At least one Sexual Attraction Facebook group                                   | 51.5     |
| At least one Chat Facebook group                                                 | 60.5     |
| At least one Secret Facebook group                                               | 73.7     |
| Mean range of subjects among Facebook groups                                    | 3.95 (2.19; 1, 9) |

Note: Numbers in parentheses are estimated standard deviation, minimum, maximum

partners from the previous 9 months. Nearly 25% reported having at least one partner who was HIV positive. Nearly half reported meeting at least one partner through mutual friends (48%) or online (46%), with far fewer reporting meeting partners at gay bars, clubs, or ballroom events (15%) or in public spaces (20%).

**Facebook network characteristics.** On average, respondents were Facebook friends with 45 other YBMSM study respondents and belonged to 11 Facebook groups. With respect to Facebook group subjects, 57% belonged to groups focused on LGBTQ identity, 52% belonged to groups emphasizing Sexual Attraction, and 61% belonged to Chat groups. Regarding group privacy,
74% were affiliated with Secret groups — i.e., groups with the greatest amount of protection from non-member Facebook users.

**Multiple Regression Analyses of Network Factors Associated with HIV Prevention and Sex Behaviors**

A series of separate multiple logistic regression analyses were performed for each prevention and sex behavior outcome to determine which network features among offline confidant and sex networks and online Facebook networks predict each outcome. Table 3 presents results for prevention outcomes and Table 4 presents results for sex behavior outcomes.

**Prevention outcomes** (Table 3). In multiple regression analysis of receiving HIV care (prevention or treatment) services from a provider, belonging to more Chat groups \([aOR = 2.82, 95\% CI: 1.18-6.76]\) was a positive and significant network predictor, while also accounting for the significant effects of being HIV positive \([aOR = 4.60, 95\% CI: 2.17-9.76]\) and being aware of PrEP \([aOR = 2.89, 95\% CI: 1.29-6.47]\). With respect to routine HIV/STI testing, only having more sex partners \([aOR = 1.59, 95\% CI: 1.09-2.33]\) had a positive effect on routine testing behavior, with several other network features reaching marginal significance at the \(p<0.10\) level, including the negative effects of meeting a partner through mutual friends \([aOR = 0.43]\) and belonging to a Facebook group focused on sexual attraction \([aOR = 0.33]\) and the positive effects of having more YBMSM Facebook friendships \([aOR = 1.25]\) and more group affiliations \([aOR = 1.09]\). Finally, receiving HIV care (prevention or treatment) services was the only significant and positive predictor of PrEP awareness \([aOR = 2.93, 95\% CI: 1.32-6.52]\). Although, meeting a partner online \([aOR = 2.93]\) and being bisexual \([aOR = 0.39]\) were marginally significant predictors \((p<0.10)\) in the positive and negative directions, respectively.

**Sex behavior outcomes** (Table 4). In multiple regression analysis of condomless sex, several confidant, sex, and Facebook network characteristics were significant predictors, while also accounting for the negative effects of having health coverage \([aOR = 0.40, 95\% CI: 0.18-0.91]\) and the positive effects of criminal justice involvement \([aOR = 3.65, 95\% CI: 1.08-12.35]\). Specifically, two confidant network characteristics were significant predictors of engagement in condomless sex. Having more confidants \([aOR = 1.44, 95\% CI: 1.04-2.00]\) positively predicted condomless sex and having a confidant who is a biological or play family member \([aOR = 0.15, 95\% CI: 0.05-0.46]\) negatively predicted condomless sex. Several sex network features were also significantly associated with condomless sex. Having at least one HIV positive partner \([aOR = 3.53, 95\% CI: 1.37-9.06]\), meeting a partner in a public space \([aOR = 3.13, 95\% CI: 1.10-8.96]\), and meeting a partner online \([aOR = 2.65; 95\% CI: 1.20-5.85]\) were all positive predictors of condomless sex. Conversely, meeting a partner through mutual friends \([aOR = 0.44, 95\% CI: 0.22-0.90]\) was a negative predictor. Finally, with respect to Facebook network features, having more YBMSM study participant Facebook friends \([aOR = 1.25; 95\% CI: 1.03-1.51]\) positively predicted condomless sex, while belonging to at least one Facebook group focused on LGBTQ identity \([aOR = 0.36; 95\% CI: 0.14-0.92]\) negatively predicted condomless sex.

Again, when examining sex drug use, several network features stand out as significant predictors. Among confidant and sex partner network features, having a confidant who is also an MSM \([aOR = 2.32; 95\% CI: 1.09-4.94]\) and meeting a partner online \([aOR = 2.96; 95\% CI:

83
Finally, meeting a sex partner online [aOR = 5.30, 95% CI: 1.38-20.27] positively predicted engagement in group sex. Although having more sex partners [aOR = 1.41] and belonging to the ballroom house or gay family communities [aOR = 2.70] were marginally significant at the p<0.10 levels.

### Table 3. Odd ratios from multiple logistic regressions showing predictive factors for prevention outcomes among young Black men who have sex with men in Chicago, USA

| Characteristics                                      | HIV Care | HIV/STI Testing | PrEP Awareness |
|-------------------------------------------------------|----------|----------------|----------------|
|                                                       | aOR  | 95% CI | aOR  | 95% CI | aOR  | 95% CI |
| **Socio-demographic and structural**                  | 0.94  | 0.81-1.08 | 0.86  | 0.72-1.02 | 1.11  | 0.95-1.29 |
| Age                                                  | 0.61  | 0.27-1.34 | 0.74  | 0.25-1.97 | 0.39  | 0.15-0.97 |
| Sexual orientation (bisexual)                        | 4.60  | 2.17-10.02 | 0.67  | 0.24-1.79 | 1.54  | 0.61-3.96 |
| HIV status (HIV+)                                    | 1.16  | 0.49-2.71 | 1.24  | 0.41-3.67 | 1.14  | 0.49-2.82 |
| Health coverage                                      | 1.35  | 0.55-3.32 | 0.94  | 0.27-2.93 | 0.75  | 0.27-2.11 |
| Housing instability (in last 12 months)              | 1.19  | 0.41-3.45 | 5.75  | 0.59-57.58 | 0.72  | 0.27-1.91 |
| Criminal justice involvement (ever)                  | 1.67  | 0.67-4.18 | 0.85  | 0.22-2.98 | 0.63  | 0.25-1.54 |
| Member of a ball house or gay family                 | 1.49  | 0.70-3.20 | 1.07  | 0.44-2.65 | 0.82  | 0.34-2.02 |
| **Behavioral factors (controls)**                    |        |         | 2.89  | 1.09-7.75 |        |         |
| Recreational marijuana use (daily or intermittent)   | 1.21  | 0.55-2.68 | 1.92  | 0.84-4.32 | 1.37  | 0.58-3.37 |
| Sex drug use                                          | 1.00  | 0.46-2.19 | 1.25  | 0.43-3.56 | 0.73  | 0.31-1.73 |
| Group sex                                             | 1.06  | 0.36-3.10 | 3.10  | 0.62-15.71 | 1.20  | 0.39-3.84 |
| HIV care                                              | —     | —      | —     | —      | 2.93  | 1.32-6.50 |
| HIV/STI tester                                        | 1.01  | 0.41-2.48 | —     | —      | 1.40  | 0.44-4.25 |
| PrEP aware                                            | 2.89  | 1.09-7.75 |        |         |        |         |
| **Confidant ego-network features**                   |        |         |        |         | 2.89  | 1.09-7.75 |
| Number of confidants                                  | 1.14  | 0.83-1.57 | 0.81  | 0.53-1.28 | 1.20  | 0.79-1.90 |
| At least one confidant who is biological / complete    | 2.17  | 0.57-8.19 | 1.48  | 0.36-5.62 | 0.52  | 0.12-2.21 |
| At least one confidant who is MSM                     | 0.62  | 0.27-1.39 | 1.24  | 0.43-3.67 | 0.90  | 0.35-2.31 |
| At least one confidant who knows their identity       | 2.03  | 0.87-4.72 | 0.43  | 0.14-1.31 | 1.09  | 0.40-2.83 |
| **Sexual ego-network features**                      |        |         |        |         | 2.89  | 1.09-7.75 |
| Number of partners in past 9 months                   | 1.14  | 0.87-1.49 | 1.59  | 1.09-2.36 | 0.78  | 0.50-1.20 |
| At least one partner who is HIV+                      | 1.75  | 0.71-4.31 | 1.75  | 0.52-5.82 | 2.67  | 0.88-8.11 |
| At least one partner met through mutual               | 0.64  | 0.29-1.38 | 0.43  | 0.17-1.19 | 0.76  | 0.33-1.79 |
| At least one partner met at bars, clubs, or events    | 2.17  | 0.61-7.66 | 1.09  | 0.25-4.77 | 1.03  | 0.22-4.63 |
| At least one partner met in public spaces             | 1.06  | 0.43-2.59 | 2.17  | 0.69-7.69 | 1.51  | 0.47-5.24 |
| At least one partner met online                       | 0.98  | 0.43-2.47 | 0.51  | 0.14-2.02 | 2.93  | 0.95-8.88 |
| **Facebook network features**                        |        |         |        |         | 2.89  | 1.09-7.75 |
| Number of Facebook friends                           | 1.01  | 0.86-1.19 | 1.25  | 0.99-1.61 | 1.10  | 0.94-1.27 |
| Number of Facebook group affiliations                 | 0.98  | 0.94-1.01 | 1.09  | 0.99-1.24 | 1.03  | 0.98-1.09 |
| At least one LGBTQ identity Facebook                 | 0.67  | 0.26-1.71 | 1.47  | 0.47-4.69 | 0.87  | 0.30-2.50 |
| At least one Sexual Attraction Facebook              | 1.06  | 0.42-2.68 | 0.33  | 0.10-1.12 | 1.12  | 0.40-3.08 |
| At least one Chat Facebook group                     | 2.82  | 1.18-6.96 | 0.72  | 0.27-2.02 | 1.46  | 0.55-4.04 |
| At least one Secret Facebook group                   | 1.08  | 0.41-2.86 | 2.61  | 0.83-8.05 | 0.69  | 0.27-1.84 |
| Range of subjects among Facebook                     | 1.04  | 0.72-1.50 | 0.84  | 0.53-1.37 | 0.86  | 0.58-1.37 |

*p<0.05, **p<0.01, ***p<0.001

[1.28-6.85] were positive predictors of sex drug use. Additionally, among Facebook network features, having more YBMSM Facebook friends [aOR = 1.17; 95% CI: 1.01-1.36] and a smaller subject matter range in one’s Facebook group portfolio [aOR = 0.68, 95% CI: 0.48-0.95] were significant predictors of sex drug use. Meanwhile, recreational use of marijuana [aOR= 2.03] was positively associated with sex drug use, albeit only marginally at the p<0.10 level.
Table 4. Odd ratios from multiple logistic regressions showing predictive factors for sex behavior outcomes among young Black men who have sex with men in Chicago, USA (N=268)

| Characteristics | Condomless Sex | Sex Drug Use | Group Sex |
|-----------------|----------------|--------------|-----------|
|                 | aOR 95% CI     | aOR 95%      | aOR 95%  |
| **Socio-demographic and structural factors (controls)** | | | |
| Age             | 0.95 0.83-1.09 | 1.06 0.93- | 1.11 0 |
| Sexual orientation (bisexual) | 1.75 0.73-4.18 | 0.76 0.32- | 1.64 0 |
| HIV status (HIV+) | 0.60 0.28-1.29 | 1.44 0.67- | 0.71 0 |
| Health coverage | **0.40 0.18-0.91*** | 1.09 0.41- | 0.43 0 |
| Housing instability (in last 12 months) | 0.57 0.25-1.31 | 1.20 0.50- | 1.06 0 |
| Criminal justice involvement (ever) | **3.65 1.08*** | 0.87 0.30- | 2.00 0 |
| Number of Facebook group affiliations | 0.43 0.17-1.07 | 0.80 0.36- | 2.70 0 |
| **Behavioral factors (controls)** | | | |
| Recreational marijuana use (daily or more) | 1.08 0.48-2.43 | 2.03 0.98- | 1.29 0 |
| Condomless Sex | — — | 1.87 0.83- | 0.50 0 |
| Sex drug use | 1.82 0.83-4.01 | — — | 2.35 0 |
| Group sex | 0.41 0.14-1.21 | 1.94 0.68- | — — |
| HIV care | 1.08 0.50-2.31 | 0.99 0.45- | 1.23 0 |
| HIV/STI tester | 1.82 0.78-4.28 | 1.01 0.37- | 3.35 0 |
| PrEP aware | 1.54 0.68-3.47 | 0.77 0.33- | 1.54 0 |
| Number of confidants | **1.44 1.04-2.00*** | 1.01 0.74- | 1.23 0 |
| At least one confidant who is biological / play family | **0.15 0.05*** | 0.71 0.22- | 1.08 0 |
| At least one confidant who is MSM | 0.93 0.42-2.06 | **2.32 1.09*** | 1.09 0 |
| At least one confidant who knows they are MSM | 1.76 0.74-4.17 | 1.04 0.47- | 0.50 0 |
| **Sexual ego-network features** | | | |
| Number of partners in past 9 months | 1.13 0.86-1.47 | 0.97 0.75- | 1.41 0 |
| At least one partner who is HIV+ | **3.53 1.37-9.06*** | 1.55 0.72- | 1.04 0 |
| At least one partner met through mutual friends | **0.44 0.22-0.90*** | 1.59 0.78- | 0.62 0 |
| At least one partner met at bars, clubs, or ball events | 2.91 0.88-9.58 | 1.10 0.41- | 2.71 0 |
| At least one partner met in public spaces | **3.13 1.10-8.96*** | 1.83 0.73- | 0.44 0 |
| At least one partner met online | **2.65 1.20-5.85*** | **2.96 1.28*** | **5.30 1*** |
| **Facebook network features** | | | |
| Number of Facebook friends | **1.25 1.03-1.51*** | 1.17 1.01- | 0.91 0 |
| Number of Facebook group affiliations | 0.98 0.95-1.02 | 1.03 0.99- | 0.97 0 |
| At least one LGBTQ Identity Facebook group | **0.36 0.14-0.92*** | 1.11 0.42- | 1.12 0 |
| At least one Sexual Attraction Facebook group | 0.78 0.30-2.07 | 0.88 0.39- | 2.00 0 |
| At least one Chat Facebook group | 1.07 0.42-2.72 | 1.45 0.61- | 1.08 0 |
| At least one Secret Facebook group | 0.78 0.28-2.21 | 1.20 0.50- | 1.60 0 |
| Range of subjects among Facebook groups | 1.31 0.91-1.90 | **0.68 0.48*** | 0.94 0 |

* p<0.05, ** p<0.01, ***p<0.001
Discussion

The ubiquity and popularity of online social networking sites (SNS) among young racial/ethnic and sexual minorities present opportunities for public health research to learn how these social environments impact critical HIV prevention and sex behaviors. To date, relatively little research has attempted to situate SNS networks within a larger, more multiplex suite of online and offline social network contexts theorized to be related to critical HIV-related behaviors. As such, the multifaceted nature of different types of networks and their structural and compositional features has gone unaddressed. In adopting a multiplex network contextual approach to our analysis, this study aimed to investigate whether or not individual, network and structural factors are associated with engagement in HIV-related behaviors, while remaining particularly focused on the effects of one type of online network — i.e., Facebook — relative to “offline” counterparts.

Our analysis revealed several features of Facebook networks that stand out as significant predictors of YBMSMs’ prevention and sex behavior engagement. With respect to prevention behaviors, individuals who belonged to at least one Chat Facebook group were significantly more likely to have received HIV prevention or treatment services from their health provider. Whether or not this means that YBMSM actually discuss HIV-related topics in these settings is difficult to determine, but the association nonetheless suggests that Facebook groups that are specifically designed to facilitate general conversations may be good intervention models for engaging YBMSM around other more specific prevention topics like PrEP. We also glean from this finding that YBMSM who do not receive prevention or treatment services from their health providers are less likely to engage in Chat groups. As such, there is a need to find alternative settings to reach this potentially vulnerable group.

Regarding sex behaviors, the degree to which an individual’s network is comprised of other gay men has been linked in previous work to sexual risk behaviors like condomless sex (B. C. Kelly, Carpiano, Easterbrook, & Parsons, 2012). In this study, we found further support for those findings. Specifically, we learned that an individual’s Facebook degree centrality (i.e., their popularity) among the other YBMSM study respondents is a positive predictor of having condomless sex and using sex drugs. Considering that we also controlled for the effect of having MSM confidants on each sex behavior, we take the effect of having MSM Facebook friends as being a unique one. For field practitioners, this presents an opportunity to engage clusters of YBMSM Facebook friends in prevention outreach.

Finally, also with respect to sex behaviors, we learned that two features of YBMSMs’ Facebook group affiliations function as a layer of protection. YBMSM who belonged to Facebook groups that focus on topics related to LGBTQ identity (e.g., being a member of the ballroom community) were less likely to engage in condomless sex, and those who belonged to a more diverse pool of Facebook groups were less likely to engage in sex drug use. Taken together, these findings suggest that YBMSM who use Facebook to seek out opportunities to talk openly with peers about being LGBTQ or to satisfy a wider variety of interests are less prone to behaviors that may put them at risk. Although prospective research is needed to better understand the mechanisms behind these associations, we interpret these results as a sign that by enabling expression of identity and interests, Facebook and other SNS can be healthy outlets for YBMSM.
We also observed a number of noteworthy higher-level trends in our findings. First, our results affirm that social networks do indeed play an integral role in carving out conditions that make YBMSM more or less vulnerable to HIV. In fact, with only one exception (PrEP awareness), we find that some aspect of an individual’s multiplex network environment — whether it is a feature of confidant, sex partner, or Facebook networks — is associated with each prevention and sex behavior. These effects can be protective in nature, as is seen in the negative association between engagement in condomless sex and having a confidant who is a family member and the positive association between having more sex partners and engaging in regular HIV/STI testing. Conversely, network effects can also be potentially risky, as is evident in the relationships between meeting a partner online and having more YBMSM Facebook friends and engagement in condomless sex. Furthermore, not only can we see that networks matter, but our findings also support the notion that multiple types of relational contexts matter, as significant effects emerge from each of the three network environments featured in our analysis.

That said, taken as a whole, network factors play a more significant role in explaining engagement in sex behaviors than prevention behaviors. This is particularly evident with respect to the factors associated with condomless sex and sex drug use, for which features of all three network environments (i.e., confidant, sex partner, and Facebook) play critical roles. Somewhat surprisingly, the network factors that we account for played no role in predicting PrEP awareness among YBMSM as others have previously found (Khanna et al., 2017); only receiving HIV prevention or treatment services from a provider helps explain who has heard about PrEP and who has not. Although it is encouraging to see that information about PrEP reaches YBMSM through health care providers, this leaves uninfluenced those who are not linked to any formal healthcare outlet. Thus, finding ways to diffuse this information through informal peer networks like those studied here will play a critical role in further increasing levels of PrEP awareness in this vulnerable community.

From the analysis featured in this study, it is difficult to explain with any kind of certainty why social networks are more predictive of sex behaviors than prevention behaviors. However, one can deduce that it may have to do with what young adults in general, and YBMSM in particular, do and do not talk about with their peers in these relational contexts. As noted previously, what YBMSM discuss in their networks often reflects their interests and norms and therefore is an important tool to leverage when trying to gain acceptance for a new idea or behavior. That being said, it is probable that many young adults might consider talking about HIV prevention with peers as antithetical to generally accepted norms, making it critical for interventionists to create spaces and opportunities within network settings where young adults can learn to talk to one another about HIV prevention and, consequently, develop new prevention-oriented communication norms.

Finally, our findings also show that there are few consistencies in the factors that significantly influence each prevention and sex behavior outcome. From a socio-environmental perspective, this demonstrates that the individual, social, and structural conditions that impact prevention and sex behaviors are unique to the behavior, even among different prevention behaviors or among different sex behaviors. The lack of generalizability across behavioral outcomes is a reminder that each behavior has its own ecology in which it thrives or declines and, therefore, must be
studied and understood on its own terms. The one notable exception to this pattern is in the consistent positive associations between each sex behavior and meeting partners online, thus affirming what prior work has found with respect to users of popular online dating applications and other internet-based venues (Garofalo et al., 2007; Horvath et al., 2006; Landovitz et al., 2013).

The findings presented here have several practical implications for HIV intervention efforts among YBMSM. First, the association between number of sex partners and following a recommended HIV and STI testing regime is promising in that having more sex partners is typically considered a first order risk factor associated with heightened HIV vulnerability. Second, having a confidant who is a member of an individual’s biological or play family was shown to have protective effects with respect to engaging in condomless sex. As prior work suggests, family structures can offer a naturally occurring mechanism through which to support the uptake of a range of HIV-prevention interventions (Schneider et al., 2012). Linkage to prevention or treatment services, for example, might be strengthened if family networks are involved in the process. Third, by focusing on how (or where) YBMSM meet their partners, we were able to identify two key locations – online venues and public spaces – associated with higher risk sex behaviors. As such, future interventions engaging YBMSM need to meet YBMSM in those spaces with targeted prevention messaging and behavioral interventions. Fourth, the negative association between belonging to Facebook groups that discuss LGBTQ identity and engaging in condomless sex suggests that there may be a certain type of discourse, rooted in an openness about being a member of the LGBTQ community, that can be leveraged explicitly for spreading awareness about sexual health and HIV prevention. And finally, the positive association between belonging to Chat groups and receiving HIV care services from a health provider inadvertently identifies a potentially vulnerable group of YBMSM — those who do not receive HIV-related services from a health provider — who may be more difficult to reach in their organic online networks. Instead, targeted interventions that strategically build online spaces where prevention topics can be discussed in private may be a more impactful way to employ online tools to engage these individuals in HIV-related care.

As with any study, our findings must be interpreted within the context of its limitations. First, our data are cross-sectional and, therefore, prevent us from making any attributions of causality. Furthermore, the cross-sectional nature of our networks impedes our ability to assess how changes in network structure and composition are potentially related to prevention and sex behavior outcomes. Future research in this area is needed, as it could help researchers identify important network dynamics implicated in ongoing HIV prevention and risk engagement.

Second, although we were able to include features of three different networks in our models, those features were limited almost entirely to compositional characteristics (i.e., characteristics of an individual’s network alters), leaving network structure largely unaddressed. The decision to prioritize network composition over structure had much to do with the egocentric methods used to collect confidant and sex partner networks, which restricted our ability to effectively capture sociocentric structure in those contexts.

Third, our analysis was designed to reveal how potentially intersecting/overlapping social contexts (i.e., socio-environmental multiplexity) independently affect HIV-related behavior.
engagement. That being said, it did not explicitly investigate the joint impact of these social contexts. In other words, the analysis remained agnostic on the overlap in social contexts as a distinct network effect. To fully understand the relationship between socio-environmental multiplexity and HIV prevention and risk engagement, we should be sure to account for the effects if tie- or network-level measures of relational overlap.

Finally, despite being the most ubiquitous SNS platform among Internet using adults, we acknowledge that Facebook is only one of many platforms that YBMSM use to engage with their peers. Other SNS like Instagram and Snapchat are rapidly increasing in popularity, especially among young racial/ethnic minorities (Greenwood et al., 2016). As such, our limited focus on Facebook meant that we captured only a single slice of what is certainly a much larger and more diverse portfolio of online networking sites being used. Prospective research is needed that explores the impacts of a wider range of SNS networks on HIV-related outcomes, which will help researchers identify a broader range of online social spaces in which at-risk YBMSM can be engaged.

Despite these limitations, this study provides critical insights on how features of YBMSMs’ multiplex network contexts may have an impact on their HIV prevention and sex behaviors, while also accounting for other known risk factors at the individual and structural levels. As the contexts in which YBMSM socialize increasingly expand into virtual social networking spaces, it behooves the research community to broaden their scope and investigate whether online peer networks support or challenge protective norms in their own right, independently of other well-studied “offline” social environments. Only then will we begin to understand the feasibility and potential impact of engaging YBMSM in their virtual networks.

References

Adimora, A. A., Schoenbach, V. J., & Doherty, I. A. (2006). HIV and African Americans in the southern United States: sexual networks and social context. Sexually transmitted diseases, 33(7), S39-S45.

Arnold, E., & Bailey, M. M. (2009). Constructing Home and Family: How the Ballroom Community Supports African American GLBTQ Youth in the Face of HIV/AIDS. J Gay Lesbian Soc Serv, 21(2-3), 171-188. doi:10.1080/10538720902772006

Barrington, C., Latkin, C., Sweat, M. D., Moreno, L., Ellen, J., & Kerrigan, D. (2009). Talking the talk, walking the walk: social network norms, communication patterns, and condom use among the male partners of female sex workers in La Romana, Dominican Republic. Social science & medicine, 68(11), 2037-2044.

Binson, D., Woods, W. J., Pollack, L., Paul, J., Stall, R., & Catania, J. A. (2001). Differential HIV risk in bathhouses and public cruising areas. American Journal of Public Health, 91(9), 1482-1486.

Black, S. R., Schmiege, S., & Bull, S. (2013). Actual versus perceived peer sexual risk behavior in online youth social networks. Translational Behavioral Medicine, 3(3), 312-319.

Boyd, D. M., & Ellison, N. B. (2007). Social network sites: Definition, history, and scholarship. Journal of Computer-Mediated Communication, 13(1).
Brewer, R. A., Magnus, M., Kuo, I., Wang, L., Liu, T.-Y., & Mayer, K. H. (2014). Exploring the relationship between incarceration and HIV among Black men who have sex with men in the United States. *Journal of acquired immune deficiency syndromes (1999)*, 65(2), 218.

Buhi, E. R., Klinkenberger, N., McFarlane, M., Kachur, R., Daley, E. M., Baldwin, J., . . . Rietmeijer, C. (2013). Evaluating the Internet as a sexually transmitted disease risk environment for teens: findings from the communication, health, and teens study. *Sexually transmitted diseases*, 40(7), 528-533.

Capurro, D., Cole, K., Echavarria, M. I., Joe, J., Neogi, T., & Turner, A. M. (2014). The use of social networking sites for public health practice and research: a systematic review. *Journal of medical Internet research, 16*(3).

CDC. (2014a). HIV and Young Men who Have Sex with Men. Retrieved from https://www.cdc.gov/hiv/library/reports/hiv-surveillance.html

CDC. (2014b). *HIV Surveillance Report*. Retrieved from https://www.cdc.gov/hiv/library/reports/hiv-surveillance.html

CDC. (2016). HIV Among African American Gay and Bisexual Men.

Chiasson, M. A., Hirshfield, S., Remien, R. H., Humberstone, M., Wong, T., & Wolitski, R. J. (2007). A comparison of on-line and off-line sexual risk in men who have sex with men: an event-based on-line survey. *JAIDS Journal of Acquired Immune Deficiency Syndromes, 44*(2), 235-243.

Cornwell, B., Schumm, L. P., Laumann, E. O., Kim, J., & Kim, Y.-J. (2014). Assessment of social network change in a national longitudinal survey. *Journals of Gerontology Series B: Psychological Sciences and Social Sciences, 69*(Suppl_2), S75-S82.

Doherty, I. A., Schoenbach, V. J., & Adimora, A. A. (2009). Sexual mixing patterns and heterosexual HIV transmission among African Americans in the southeastern United States. *Journal of acquired immune deficiency syndromes (1999)*, 52(1), 114.

Fichtenberg, C. M., Muth, S. Q., Brown, B., Padian, N. S., Glass, T. A., & Ellen, J. M. (2009). Sexual network position and risk of sexually transmitted infections. *Sexually transmitted infections*.

Friedman, S. R., Neaigus, A., Jose, B., Curtis, R., Goldstein, M., Ildefonso, G., . . . Des Jarlais, D. C. (1997). Sociometric risk networks and risk for HIV infection. *American Journal of Public Health, 87*(8), 1289-1296.

Friedman, S. R., Sandoval, M., Mateu-Gelabert, P., Rossi, D., Gwadz, M., Dombrowski, K., . . . Perlman, D. (2013). Theory, measurement and hard times: some issues for HIV/AIDS research. *AIDS and Behavior, 17*(6), 1915-1925.

Frost, D. M., Meyer, I. H., & Schwartz, S. (2016). Social support networks among diverse sexual minority populations. *American Journal of Orthopsychiatry, 86*(1), 91.

Fujimoto, K., Flash, C. A., Kuhns, L. M., Kim, J.-Y., & Schneider, J. A. (2018). Social networks as drivers of syphilis and HIV infection among young men who have sex with men. *Sex Transm Infect, 2017*.

Fujimoto, K., Wang, P., Ross, M. W., & Williams, M. L. (2015). Venue-mediated weak ties in multiplex HIV transmission risk networks among drug-using male sex workers and associates. *Journal of Public Health, 105*(6), 1128-1135. doi:10.2105/AJPH.2014.302474

Fujimoto, K., Williams, M. L., & Ross, M. W. (2013). Venue-based affiliation networks and HIV risk-taking behavior among male sex workers. *Sexually transmitted diseases, 40*(6), 453.

Gamarel, K. E., Nelson, K. M., Stephenson, R., Santiago Rivera, O. J., Chiaramonte, D., & Miller, R. L. (2017). Anticipated HIV Stigma and Delays in Regular HIV Testing
Behaviors Among Sexually-Active Young Gay, Bisexual, and Other Men Who Have Sex with Men and Transgender Women. *AIDS and Behavior*. doi:10.1007/s10461-017-2005-1

Gardenier, D., Andrews, C. M., Thomas, D. C., Bookhardt-Murray, L. J., & Fitzpatrick, J. J. (2010). Social support and adherence: differences among clients in an AIDS day health care program. *Journal of the Association of Nurses in AIDS Care, 21*(1), 75-85.

Garofalo, R., Herrick, A., Mustanski, B. S., & Donenberg, G. R. (2007). Tip of the iceberg: Young men who have sex with men, the Internet, and HIV risk. *American Journal of Public Health, 97*(6), 1113-1117.

Gile, K. J. (2011). Improved inference for respondent-driven sampling data with application to HIV prevalence estimation. *Journal of the American Statistical Association*.

Gile, K. J., & Handcock, M. S. (2010). Respondent - driven sampling: An assessment of current methodology. *Sociological methodology, 40*(1), 285-327.

Goedel, W. C., & Duncan, D. T. (2015). Geosocial-networking app usage patterns of gay, bisexual, and other men who have sex with men: Survey among users of Grindr, a mobile dating app. *JMIR Public health and surveillance, 1*(1).

Goel, S., & Salganik, M. J. (2010). Assessing respondent-driven sampling. *Proc Natl Acad Sci USA, 107*(15), 6743-6747. doi:10.1073/pnas.1000261107

Gould, P. R. (1967). On the Geographical Interpretation of Eigenvalues. *Transactions of the Institute of British Geographers*(42), 53-86. doi:10.2307/621372

Greenwood, S., Perrin, A., & Duggan, M. (2016). *Social Media Update 2016*. Retrieved from Pew Research Center: [http://www.pewinternet.org/2016/11/11/social-media-update-2016/](http://www.pewinternet.org/2016/11/11/social-media-update-2016/)

Grosskopf, N. A., LeVasseur, M. T., & Glaser, D. B. (2014). Use of the internet and mobile-based “apps” for sex-seeking among men who have sex with men in New York City. *American journal of men's health, 8*(6), 510-520.

Grov, C., Parsons, J. T., & Bimbi, D. S. (2007). Sexual risk behavior and venues for meeting sex partners: an intercept survey of gay and bisexual men in LA and NYC. *AIDS and Behavior, 11*(6), 915-926.

Harawa, N. T., Williams, J. K., Ramamurthi, H. C., Manago, C., Avina, S., & Jones, M. (2008). Sexual behavior, sexual identity, and substance abuse among low-income bisexual and non-gay-identifying African American men who have sex with men. *Archives of sexual behavior, 37*(5), 748-762.

Harris, P. I. (2008). Gay and lesbian adults are reading and responding to more blogs than heterosexuals. from Harris Poll Interactive

Heckathorn, D. D. (1997). Respondent-Driven Sampling: A New Approach to the Study of Hidden Populations. *Social Problems, 44*(2), 174.

Holloway, I. W., Dunlap, S., Del Pino, H. E., Hermanstyne, K., Pulsipher, C., & Landovitz, R. J. (2014). Online social networking, sexual risk and protective behaviors: considerations for clinicians and researchers. *Current addiction reports, 1*(3), 220-228.

Horvath, K. J., Bowen, A. M., & Williams, M. L. (2006). Virtual and physical venues as contexts for HIV risk among rural men who have sex with men. *Health Psychology, 25*(2), 237.

Javanbakht, M., Murphy, R., Harawa, N. T., Smith, L. V., Hayes, M., Chien, M., & Kerndt, P. R. (2009). Sexually transmitted infections and HIV prevalence among incarcerated men who have sex with men, 2000–2005. *Sexually transmitted diseases, 36*(2), S17-S21.
Kelly, B. C., Carpio, R. M., Easterbrook, A., & Parsons, J. T. (2012). Sex and the community: the implications of neighbourhoods and social networks for sexual risk behaviours among urban gay men. Sociology of health & illness, 34(7), 1085-1102.

Kelly, J. A., Murphy, D. A., Sikkema, K. J., McAuliffe, T. L., Roffman, R. A., Solomon, L. J., . . . Collaborative, T. C. H. I. V. P. R. (1997). Randomised, controlled, community-level HIV-prevention intervention for sexual-risk behaviour among homosexual men in US cities. The Lancet, 350(9090), 1500-1505.

Kelly, J. A., St Lawrence, J. S., Diaz, Y. E., Stevenson, L. Y., Hauth, A. C., Brasfield, T. L., . . . Andrew, M. E. (1991). HIV risk behavior reduction following intervention with key opinion leaders of population: an experimental analysis. American Journal of Public Health, 81(2), 168-171.

Khanna, A. S., Michaels, S., Skaathun, B., Morgan, E., Green, K., Young, L., & Schneider, J. (2016). Preexposure Prophylaxis Awareness and Use in a Population-Based Sample of Young Black Men Who Have Sex With Men. JAMA internal medicine, 176(1), 136-138.

Khanna, A. S., Schumm, P., & Schneider, J. (2017). Facebook network structure and awareness of preexposure prophylaxis among young men who have sex with men. Annals of Epidemiology, 27(3), 176-180.

Kipke, M. D., Montgomery, S. B., Simon, T. R., Unger, J. B., & Johnson, C. J. (1997). Homeless youth: Drug use patterns and HIV risk profiles according to peer group affiliation. AIDS and Behavior, 1(4), 247-259.

Kuhns, L. M., Hotton, A. L., Schneider, J., Garofalo, R., & Fujimoto, K. (2017). Use of pre-exposure prophylaxis (PrEP) in young men who have sex with men is associated with race, sexual risk behavior and peer network size. AIDS and Behavior, 21(5), 1376-1382.

Lakon, C. M., Ennett, S. T., & Norton, E. C. (2006). Mechanisms through which drug, sex partner, and friendship network characteristics relate to risky needle use among high risk youth and young adults. Social science & medicine, 63(9), 2489-2499.

Landovitz, R. J., Tseng, C.-H., Weissman, M., Haymer, M., Mendenhall, B., Rogers, K., . . . Shoptaw, S. (2013). Epidemiology, sexual risk behavior, and HIV prevention practices of men who have sex with men using GRINDR in Los Angeles, California. Journal of Urban Health, 90(4), 729-739.

Lapinski, M. K., & Rimal, R. N. (2005). An explication of social norms. Communication theory, 15(2), 127-147.

Latkin, C. A., Forman, V., Knowlton, A., & Sherman, S. (2003). Norms, social networks, and HIV-related risk behaviors among urban disadvantaged drug users. Social science & medicine, 56(3), 465-476.

Latkin, C. A., Hua, W., & Forman, V. L. (2003). The relationship between social network characteristics and exchanging sex for drugs or money among drug users in Baltimore, MD, USA. Int J STD AIDS, 14(11), 770-775. doi:10.1258/09564620360719831

Latkin, C. A., Sherman, S., & Knowlton, A. (2003). HIV prevention among drug users: outcome of a network-oriented peer outreach intervention. Health Psychology, 22(4), 332.

Laumann, E. O., Gagnon, J. H., Michael, R. T., & Michaels, S. (1996). National Health and Social Life Survey, 1992: Inter-university Consortium for Political and Social Research.

Liau, A., Millett, G., & Marks, G. (2006). Meta-analytic examination of online sex-seeking and sexual risk behavior among men who have sex with men. Sexually transmitted diseases, 33(9), 576-584.
Millett, G. A., Flores, S. A., Peterson, J. L., & Bakeman, R. (2007). Explaining disparities in HIV infection among black and white men who have sex with men: a meta-analysis of HIV risk behaviors. AIDS, 21(15), 2083-2091. doi:10.1097/QAD.0b013e3282e9a64b

Millett, G. A., Malebranche, D., Mason, B., & Spikes, P. (2005). Focusing "down low": bisexual black men, HIV risk and heterosexual transmission. Journal of the National Medical Association, 97(7 Suppl), 52S.

Mimiaga, M. J., Reisner, S., Bland, S., Skeer, M., Cranston, K., Isenberg, D., . . . Mayer, K. H. (2009). Health system and personal barriers resulting in decreased utilization of HIV and STD testing services among at-risk black men who have sex with men in Massachusetts. AIDS Patient Care STDS, 23(10), 825-835. doi:10.1089/apc.2009.0086

Moreno, M. A., Brockman, L., Rogers, C. B., & Christakis, D. A. (2010). An evaluation of the distribution of sexual references among “Top 8” MySpace friends. Journal of Adolescent Health, 47(4), 418-420.

Moreno, M. A., Parks, M. R., Zimmerman, F. J., Brito, T. E., & Christakis, D. A. (2009). Display of health risk behaviors on MySpace by adolescents: prevalence and associations. Archives of pediatrics & adolescent medicine, 163(1), 27-34.

Morgan, E., Khanna, A. S., Skaathun, B., Michaels, S., Young, L., Duvoisin, R., . . . Schneider, J. A. (2016). Marijuana Use Among Young Black Men Who Have Sex With Men and the HIV Care Continuum: Findings From the uConnect Cohort. Substance use & misuse, 51(13), 1751-1759. doi:10.1080/10826084.2016.1197265

Morris, M., & Kretzschmar, M. (1995). Concurrent partnerships and transmission dynamics in networks. Social Networks, 17(3), 299-318.

Mustanski, B., Lyons, T., & Garcia, S. C. (2011). Internet use and sexual health of young men who have sex with men: A mixed-methods study. Archives of sexual behavior, 40(2), 289-300.

Parker, M., Ward, H., & Day, S. (1998). Sexual networks and the transmission of HIV in London. Journal of biosocial science, 30(1), 63-83.

Périssé, A. R. S., & Nery, J. A. d. C. (2007). The relevance of social network analysis on the epidemiology and prevention of sexually transmitted diseases. Cadernos de Saúde Pública, 23, S361-S369.

Perrin, A. (2015). Social networking usage: 2005-2015. Retrieved from Pew Research Center: http://www.pewinternet.org/2015/10/08/Social-Networking-Usage-2005-2015/

Rhodes, T., Singer, M., Bourgois, P., Friedman, S. R., & Strathdee, S. A. (2005). The social structural production of HIV risk among injecting drug users. Soc Sci Med, 61(5), 1026-1044. doi:10.1016/j.socscimed.2004.12.024

Rhodes, T., Wagner, K., Strathdee, S. A., Shannon, K., Davidson, P., & Bourgois, P. (2012). Structural Violence and Structural Vulnerability Within the Risk Environment: Theoretical and Methodological Perspectives for a Social Epidemiology of HIV Risk Among Injection Drug Users and Sex Workers. In P. O’Campo & J. R. Dunn (Eds.), Rethinking Social Epidemiology: Towards a Science of Change (pp. 205-230). Dordrecht: Springer Netherlands.

Rice, E., Barman-Adhikari, A., Milburn, N. G., & Monro, W. (2012). Position-specific HIV risk in a large network of homeless youths. American Journal of Public Health, 102(1), 141-147.

Rice, E., Holloway, I., Winetrobe, H., Rhoades, H., Barman-Adhikari, A., Gibbs, J., . . . Dunlap, S. (2012). Sex risk among young men who have sex with men who use Grindr, a
smartphone geosocial networking application. *Journal of AIDS & clinical research, S4*, 1-8.

Rice, E., Milburn, N. G., & Rotheram-Borus, M. J. (2007). Pro-social and problematic social network influences on HIV/AIDS risk behaviours among newly homeless youth in Los Angeles. *AIDS care, 19*(5), 697-704.

Schneider, J. (2013). Sociostructural 2-mode network analysis: critical connections for HIV transmission elimination. *Sexually transmitted diseases, 40*(6), 459-461.

Schneider, J., Cornwell, B., Jonas, A., Lancki, N., Behler, R., Skarthun, B., . . . , Laumann, E. (2017). Network dynamics of HIV risk and prevention in a population-based cohort of young Black men who have sex with men. *Network Science, 5*(1), 1-29. doi:10.1017/nws.2016.27

Schneider, J., Cornwell, B., Ostrow, D., Michaels, S., Schumm, P., Laumann, E. O., & Friedman, S. (2013). Network mixing and network influences most linked to HIV infection and risk behavior in the HIV epidemic among black men who have sex with men. *American Journal of Public Health, 103*(1), e28-e36.

Schneider, J., Michaels, S., & Bouris, A. (2012). Family network proportion and HIV risk among black men who have sex with men. *Journal of Acquired Immune Deficiency Syndrom, 15*(61), 627-635. doi:10.1097/QAI.0b013e318270d3cb

Shah, N. S., Iveniuk, J., Muth, S. Q., Michaels, S., Jose, J.-A., Laumann, E. O., & Schneider, J. A. (2014). Structural bridging network position is associated with HIV status in a younger Black men who have sex with men epidemic. *AIDS and Behavior, 18*(2), 335-345.

Smith, R., Rossetto, K., & Peterson, B. L. (2008). A meta-analysis of disclosure of one's HIV-positive status, stigma and social support. *AIDS care, 20*(10), 1266-1275. doi:10.1080/09540120801926977

StataCorp. (2017). Stata Release: 15. Statistical Software. College Station, TX: StataCorp, LLC.

Taylor, P. (2013). *A survey of LGBT Americans: attitudes, experiences and values in changing times*: Pew Research Center.

Tobin, K. E., & Latkin, C. A. (2017). Social Networks of HIV Positive Gay Men: Their Role and Importance in HIV Prevention. In *Understanding Prevention for HIV Positive Gay Men* (pp. 349-366): Springer.

Traud, A. L., Mucha, P. J., & Porter, M. A. (2012). Social structure of Facebook networks. *Physica A: Statistical Mechanics and its Applications, 391*(16), 4165-4180. doi:https://doi.org/10.1016/j.physa.2011.12.021

Volz, E., & Heckathorn, D. D. (2008). Probability based estimation theory for respondent driven sampling. *Journal of official statistics, 24*(1), 79.

Wellman, B., & Frank, K. (2001). Network capital in a multilevel world: Getting support from personal communities. *Social capital: Theory and research, 233*-273.

Whiteley, L. B., Brown, L. K., Swenson, R. R., Romer, D., DiClemente, R. J. P., Salazar, L. F., . . . , Valois, R. F. (2011). African American adolescents and new media: Associations with HIV/STI risk behavior and psychosocial variables. *Ethnicity & disease, 21*(2), 216.

Winetrobe, H., Rice, E., Bauermeister, J., Petering, R., & Holloway, I. W. (2014). Associations of unprotected anal intercourse with Grindr-met partners among Grindr-using young men who have sex with men in Los Angeles. *AIDS care, 26*(10), 1303-1308.

Wohl, A. R., Galvan, F. H., Myers, H. F., Garland, W., George, S., Witt, M., . . . , Lee, M. L. (2011). Do Social Support, Stress, Disclosure and Stigma Influence Retention in HIV
Care for Latino and African American Men Who Have Sex with Men and Women? *AIDS and Behavior, 15*(6), 1098-1110. doi:10.1007/s10461-010-9833-6

Yang, C., Latkin, C. A., Luan, R., & Nelson, K. (2010). Peer norms and consistent condom use with female sex workers among male clients in Sichuan province, China. *Social science & medicine, 71*(4), 832-839. doi:https://doi.org/10.1016/j.socscimed.2010.04.039

Yonker, L. M., Zan, S., Scirica, C. V., Jethwani, K., & Kinane, T. B. (2015). “Friending” teens: systematic review of social media in adolescent and young adult health care. *Journal of medical Internet research, 17*(1).

Young, L. E., Fujimoto, K., & Schneider, J. (2018). HIV prevention and sex behaviors as organizing mechanisms in a Facebook group affiliation network among young Black men who have sex with men. *AIDS and Behavior, 22*, 3324-3334. doi:doi.org/10.1007/s10461-018-2087-4

Young, L. E., Jonas, A. B., Michaels, S., Jackson, J. D., Pierce, M. L., & Schneider, J. (2017). Social-structural properties and HIV prevention among young men who have sex with men in the ballroom house and independent gay family communities. *Social science & medicine, 174*, 26-34. doi:10.1007/s10461-017-1679-8

Young, S. D., & Jordan, A. H. (2013). The influence of social networking photos on social norms and sexual health behaviors. *Cyberpsychology, behavior, and social networking, 16*(4), 243-247.

Young, S. D., & Rice, E. (2011). Online social networking technologies, HIV knowledge, and sexual risk and testing behaviors among homeless youth. *AIDS and Behavior, 15*(2), 253-260.

Young, S. D., Szekeres, G., & Coates, T. (2013). The relationship between online social networking and sexual risk behaviors among men who have sex with men (MSM). *PLoS One, 8*(5), e62271. doi:10.1371/journal.pone.0062271