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Validation of tie corroboration and reported alter characteristics among a sample of young men who have sex with men

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Abstract

The differences between direct ties (i.e., ties between a respondent and their nominees) and ties between nominees (indirect) are key to understanding network structure, yet remain understudied. Within a sample of 175 young men who have sex with men, we explored the corroboration of sex and drug ties, and factors associated with corroboration. The majority of instances in which there was no corroboration for either sex or drug ties was due to one individual not appearing in another respondent's network. When an individual did appear in another respondent's network, direct sex and drug ties were corroborated in most cases. We also found that more indirect sex ties were corroborated than direct sex ties (95.7% vs. 88.9%), but the reverse was true for indirect versus direct drug ties (73.1% vs. 84.1%). Strength of relationship and frequency of communication were both associated with confirmed direct ties, but not with indirect ties. Based on these findings, we recommend that direct and indirect ties be treated differently in network analyses.

Keywords

Macronetwork; tie corroboration; HIV; YMSM

INTRODUCTION

Due to a greater focus on social contextual influences on health, network data are increasingly of interest to social and behavioral researchers. However, the capture and analysis of these data brings with it numerous methodological complexities (Adams & Moody, 2007; Bell, Belli-McQueen, & Haider, 2007; Marsden, 1990). Much of this complexity stems from the fact that information about a network is typically self-reported by a single individual. Information reported by a single study participant (ego) relies on that individual's perceptions of their network members (alters), and their accurate recall of alter names and report of alter characteristics. However, there are two major instances in which omission in recall could affect the network structure: 1) An ego has a tie with an alter, but does not nominate them - Research has found that egos often omit known alters within

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network interviews (Bell et al., 2007; Brewer, Garrett, & Kulasingam, 1999). This pattern of omission can at least partially be explained by cognitive biases toward remembering long-term stable relationships and forgetting short-term interactions regarding particular events (Freeman, Romney, & Freeman, 1987; Marsden, 1990). 2) An ego is aware of a tie between two alters, but does not indicate this in the network interview – Similar to research done with alter reporting, it is highly probable that an ego would omit a tie between two alters if they were not close or if their connection only occurred once (i.e., one-night stand). A third explanation for the omission of a tie between two alters is the simplest one – the ego is not aware of this tie, and therefore could not report on it.

Beyond mere alter recall is the need for the ego to report on specific characteristics of their nominated alters. These can range from simple demographics (age, race, etc.) to sexual activities (i.e., did Person 1 have sex with Person 2?). The quality of reporting on these factors ranges, and is particularly reliant on the type of information collected. For instance, “asymmetric information,” or alter characteristics that are rarely known by the ego, such as HIV status, are likely to be less accurate than age or race (Shelley, Bernard, Killworth, Johnsen, & Mccarty, 1995).

Within egocentric networks, there are both direct and indirect ties between individuals. Ties from an ego to an alter are considered direct ties, whereas ties between alters are considered indirect ties. Figure 1 and 2 outline common scenarios that occur when egocentric data are obtained from individuals with overlapping networks. More specifically, Figure 1a represents the classic egocentric scenario where a respondent (R_1 ; i.e., an individual who completed an egocentric interview) reports on a nominated person (N_1) that was not interviewed, and therefore the accuracy of this tie cannot be verified. Figure 1b presents a less common scenario, where a respondent reports another respondent (R_2) within their network. In this case, we can investigate the accuracy of R_1 's report by examining if R_2 also reports the tie. Figure 2a again presents a classic egocentric scenario where a tie between two nominated persons (N_1 and N_2) is reported by a respondent (R_1) but cannot be verified. However, in the case (Figure 2b) where a respondent (R_1) reports a tie between a nominated person (N_1) and another respondent (R_2), the accuracy of this perceived tie can be validated against R_2 's own report. Finally, a unique scenario is shown in Figure 2c where a respondent (R_1) reports a tie between two individuals and both individuals are respondents (R_2 and R_3). In this scenario, we have two sources to examine the validity of a perceived tie in both R_2 's and R_3 's report. In any of the scenarios discussed there are also two possible sources of error that could explain an uncorroborated tie across respondent reports: false positives and false negatives. A false positive would occur when one of the respondents reports a tie that does not exist while a false negative would occur when a respondent fails to report a tie that actually exists. Unfortunately, in overlapping egocentric datasets, both errors could appear as a tie reported by one respondent and not corroborated by another.

Most research into error in network measurement has focused on comparing the accuracy of self-report data to behavioral (Killworth & Bernard, 1976) or other forms (Kumbasar, Romney, & Batchelder, 1994) (e.g., consensus from multiple observations) of independent measurement. Less attention has been paid to the difference between direct and indirect tie reporting. Yet, in most analyses of network data, the distinction between self-reported

(direct) and indirect information is ignored; by default, this treats both cases as equally valid. A reported sex tie between a respondent and a nominated person is considered to be as valid as a reported sex tie between two nominees, despite the increased likelihood of inaccuracy in reporting in the former case. Therefore, investigation into the correspondence between direct and indirect information, specifically the existence of ties, becomes vital in understanding the entire network of interest.

Prior research into the validity of indirect information has had mixed results. A social network study of 39 HIV-positive individuals in Uganda found high accuracy for gender, age, and pregnancy status – all factors that can be determined without being close to an alter (Green, Hoover, Wagner, Ryan, & Ssegujja, 2014). However, less observable characteristics, such as receipt of advice between alters, were more inaccurate. Researchers also found that there were no key personal predictors of reporting accuracy – accuracy was driven more by the respondent-nominee relationship. One of the few studies to compare the accuracy of direct versus indirect ties found that directly-reported ties were more likely to be corroborated than reports between two alters, as would be expected (Adams & Moody, 2007). Similarly, related research examining the accuracy of third party report of family history data has found mixed results with general support for the accuracy of reporting alcohol problems (Waldron et al., 2012) but less support for sexual orientation. (Kirk, Bailey, & Martin, 1999) This suggests the accuracy of indirect information likely varies depending on the specific type of behavior or attribute being assessed.

Developing an accurate picture of the ties between network members is vital to understanding the spread of diseases, such as HIV, within a network. In the United States, HIV incidence has stabilized or decreased in nearly all risk groups except in young men who have sex with men (YMSM); HIV diagnoses among MSM aged 13-24 years accounted for 67% of infections among youth in 2008, but increased to 80% in 2013 (Centers for Disease Control and Prevention, 2015). Therefore, it is important to investigate how social and sexual networks among YMSM influence risk behaviors for HIV transmission such as condomless anal sex (Kapadia et al., 2013; Tucker et al., 2012). Furthermore, network structural characteristics such as concurrency, degree, and clustering may also provide key insights into the disparities in transmission of HIV through YMSM sexual networks that cannot be explained by individual risk behavior alone (Birkett, Kuhns, Latkin, Muth, & Mustanski, 2015; Mustanski, Birkett, Kuhns, Latkin, & Muth, 2015; Shah et al., 2014).

Studies in which first-hand data are collected on respondents and nominees are rare. In our network study of a small and circumscribed population – YMSM – a substantial portion of respondents were nominated by other respondents during their network interview; therefore, we have a unique opportunity to examine the correspondence between direct and indirect reporting of ties, and characteristics of these alters. We hypothesize that ties are less likely to be corroborated when the relationship between the respondent and the nominee is weaker, and that this will have a more substantial effect on indirect ties. We also anticipate that direct ties will be much more likely to be corroborated than indirect ties.

METHODS

Participants

Participants in a longitudinal study of HIV and other health issues affecting YMSM in Chicago (Crew 450) were asked to participate in a one-time network interview to describe their social, sexual, and drug use networks (Kuhns et al., 2015). Between June 2011 and October 2012, 175 participants were contacted, enrolled, and completed this network study. In order to be eligible for the parent study, individuals had to report being assigned a male sex at birth, aged 16-20 years at enrollment, speak English, report a sexual encounter with a male or a gay/bisexual identity, and be available for two years of follow-up. This study was approved by Institutional Review Boards at the sites, and participants were provided with \$25 for their time.

Procedures

Information was collected using a participant-aided egocentric data approach (Hogan, Carrasco, & Wellman, 2007), in which respondents provided information on their perceptions of their alters, rather than through first-hand interviews with the alters themselves. Specific details used in obtaining network data have previously been described (Kuhns et al., 2015). Briefly, nine name generator questions were used to elicit people with whom the participant had a social, sexual, or drug use connection. Study participants could nominate up to 40 alters, although only 7 (4.0%) reached the upper limit. Participants then provided demographic information to characterize each network member and identified any connections between network members.

Matching

Within this study, potential matches were identified through a variety of methods. A probabilistic matching software – Link Plus (CDC, 2011) – was used to identify potential matches. Record pairs were assigned a score from 0 to 30; clear matches have scores over 20, scores between 10 and 20 are unclear and require further investigation, and scores under 10 are typically non-matches. For this project, all record pairs with scores of at least 2.5 were examined manually and matched based on decisions by two independent reviewers. Follow-up phone calls were made to respondents to clarify any unclear matches, and then list sorts were used to make final matches (e.g., sorting data by first/last name). More details about the matching process have been presented elsewhere (Birkett, Kuhns, Mustanski, & Muth, 2012). Within the egocentric network, 836 matched individuals were identified and collapsed into 338 individuals. The resulting macronetwork contained 3140 nodes.

Analysis

This paper will explore three forms of tie corroboration to assess respondent reporting accuracy of sex and drug ties represented in Figures 1b, 2b, and 2c. In each scenario we will examine the proportion of ties that were corroborated by the other respondents and probe potential explanations for lack of corroboration. Given the importance of drug and sex networks to public health, and the more objective nature of these ties (i.e., compared to ‘closeness’ or ‘friendship’ between individuals), we focus specifically on these tie types in

our analysis. Specifically, we will examine closeness and frequency of communication among dyads as a predictor of tie corroboration. Furthermore, for respondent-respondent ties that are corroborated, we can also explore the congruency between each participant's reported date of first sex, frequency of communication, strength of relationship, relationship roles, and the accuracy of partner characteristics (i.e., gender, age, race) in an effort to further examine the agreement between each participant's reports. To do this, we examined the reported frequency of contact and strength of relationship between respondents in these dyads. For confirmed ties, the mean value for each of these variables was used; for unconfirmed ties, the values from the respondent reporting the tie were used.

RESULTS

The 175 respondents interviewed reported a median of 17 alters (range: 5 – 40). Nearly half of respondents, 94 (53.7%) could be matched with at least one nominee in another respondent's reported network. The number of respondent/nominee matches across the 175 interviews ranged from 2 to 7, with a mean of 1.91 matches (standard deviation [sd] = 1.27).

Validity of Reported Sex Networks

Direct Tie Corroboration—To assess the validity of nominations as sex partners, reported sex ties between two respondents were examined to see if the tie was reported by a single respondent or was reported by both (i.e., a confirmed sex tie). A total of 68 respondents (38.9%) indicated a sex tie with another respondent, for a total of 49 unique sex ties between respondents (Table 1). In 18 of these 49 ties (36.7%), Respondent 2 (R_2) was included in Respondent 1 (R_1)'s network; the majority of these ties were confirmed by both participants (16; 88.9%). When looking more closely at the remaining 2 unconfirmed ties, R_1 s reported R_2 in their network but failed to report a sex tie (i.e., they were reported as a social or drug tie but *not* a sex tie). The remaining unique sex ties were unconfirmed because R_2 was not included in R_1 's network (31; 63.3%). Furthermore, there was only one instance in which the absence of a corroborated sex tie could be attributed to R_1 's interview date occurring before the date of first sex, as reported by R_2 .

Looking at the bivariate associations in a logistic regression model predicting the confirmation of a sex tie (Table 2), both frequency of contact (odds ratio [OR] = 1.81; 95% confidence interval [CI]: 1.17, 3.14; $p = 0.016$) and relationship strength (OR = 3.73; 95% CI: 1.55, 11.05; $p = 0.007$) predicted tie corroboration. Within the subset of 16 ties that were corroborated, we also examined if corroborated ties were characterized in a similar manner (e.g., strength of relationship, frequency of communication, and first date of sex). Of these, 12 dyads both indicated the same level of relationship strength. Of the 4 dyads that differed, there were 3 cases in which one respondent reported a “very close” relationship while the other reported being “not very close.” A smaller proportion of dyads (37.5%) reported the same frequency of communication. In most cases, the reported frequencies were similar (1-2 times a week vs. 3-4 times a week). Within the corroborated ties, 12 dyads (75.0%) reported the same relationship role for their partner (e.g., boyfriend, best friend).

Comparing perceptions of R_2 s' characteristics to self-report characteristics demonstrated high levels of concordance. All but two R_1 s (96.9%) correctly reported their sex partner's

gender; in both cases, the partner identified as transgender while R_2 reported they were the gender as which they presented. Similarly, the majority of R_1 s (90.8%) reported the correct race of their sex partner; in all instances of misattributed reports of a respondent's race, one of the respondents reported their race as Hispanic or Other. Finally, most R_1 s (83.1%) reported their partner's age within 1 year of their partner's actual age.

Indirect Tie Corroboration—Regarding the validity of indirect reported ties between a nominee (N_1) and another respondent (R_2), 45 R_2 s were reported to have a sex tie with another respondent's alter, representing 67 instances where R_1 perceived a sex tie between R_2 and one of R_2 's alters (N_1 ; Figure 2b). More than one-third of the unique indirect ties (34.3%) were cases in which N_1 was in both R_1 's and R_2 's network (Table 1). Of these 23 cases, 22 (95.7%) were confirmed by R_2 ; only a single instance (4.3%) existed where N_1 was in R_2 's network but was not indicated as a sex tie. The remainder of indirect ties were not confirmed because N_1 was not reported in R_2 's network (44; 65.7%). Looking at predictors of confirmed ties, neither R_1 's frequency of communication (OR = 1.60; 95% CI: 0.97, 2.98; $p = 0.09$) nor strength of relationship (OR = 1.45, 95% CI: 0.70, 3.30; $p = 0.34$) with R_2 were significant predictors of a confirmed tie. Similarly, neither R_1 's frequency of communication (OR = 1.03; 95% CI: 0.75, 1.44; $p = 0.82$) or strength of relationship (OR = 0.84; 95% CI: 0.44, 1.57; $p = 0.34$) with N_1 were significantly associated with a perceived tie being confirmed by R_2 .

Validity of Reported Drug Networks

Direct Tie Corroboration—For drug networks, 94 respondents (53.7%) reported a drug tie with another respondent, for a total of 89 unique drug ties between respondents (Table 1). In 44 of these ties (49.4%), R_2 was included in R_1 's network; the majority of these ties were confirmed by both respondents (37; 84.1%). Slightly more than half of these drug ties were instances in which R_1 was not reported in R_2 's network. While frequency of communication (OR = 1.73; 95% CI: 1.20, 2.66; $p = 0.007$) was significantly associated with drug tie corroboration, strength of relationship (OR = 1.87; 95% CI: 0.97, 3.84; $p = 0.07$) was not significantly associated (Table 2).

Of the 37 corroborated ties, 21 (56.8%) of these dyads had respondents who reported the same strength of relationship. Similarly, 19 (51.3%) of these dyads had respondents who reported the same frequency of contact. Looking at concordance of role selection for corroborated drug ties, 30 (81.1%) of the corroborated dyads involved both respondents reporting the same relationship role for their drug partner. Similar to sex partner characteristics, R_1 s were relatively accurate at reporting their partner characteristics: 97.6% accurately reported their partner's gender, 91.3% accurately reported their partner's race, and 87.0% accurately reported their partner's age (i.e., within 1 year of their actual age).

Indirect Tie Corroboration—For drug networks, there were 41 R_1 s that reported 52 unique drug ties between N_1 and another ego (R_2). One-half of these unique indirect ties (50.0%) were cases in which N_1 was in both R_1 's and R_2 's network (Table 1). Of these 26 cases, 19 (73.1%) were confirmed by R_2 ; the rest of these cases were situations in which N_1 was in R_2 's network but was not indicated as a drug tie. The remainder of indirect ties were

not confirmed because N_1 was not reported in R_2 's network (26; 50.0%). Examining predictors of indirect tie corroboration, neither R_1 's closeness to ($OR = 1.66$; 95% CI: 0.98, 3.27; $p = 0.09$) nor frequency of communication with ($OR = 1.90$; 95% CI: 0.80, 5.37; $p = 0.18$) R_2 predicted a confirmed tie. Similarly, neither R_1 's strength of relationship ($OR = 0.81$; 95% CI: 0.41, 1.54; $p = 0.53$) nor frequency of communication ($OR = 1.05$; 95% CI: 0.75, 1.50; $p = 0.77$) with N_1 predicted tie corroboration.

DISCUSSION

Within both direct and indirect ties, one-half or fewer unique ties had the potential for being corroborated. Predominantly, across all network and tie types, ties could not be corroborated simply because an individual was not reported in the respondent's network. This could be due to a variety of factors. Respondents could interpret the term "sex" in different ways, as it was not explicitly defined in the name generator; some might assume this refers exclusively to anal or vaginal sex and not indicate oral sex partners. Individuals could have varying levels of knowledge about their partners – for instance, it is much more difficult to remember details (name, age, etc.) about an anonymous or one-time sex partner than about a serious partner. This lack of partner information would make it exceedingly difficult for individuals to be matched across networks. Similarly, one-time events might not be as easily remembered when an respondent is trying to recall his alters, particularly in instances where the respondent already has multiple sex or drug partners (Brewer et al., 1999). The most likely explanation, as posited in the Introduction, is that respondents omitted nominees, although the reason is unclear. Further research is necessary to understand whether these omissions are conscious or unconscious, and if any of these proposed reasons are key.

When looking within cases where an individual was reported in the respondent's network and could be named as a sex or drug partner, we found high proportions of direct tie confirmations, both for sex ties (88.9%) and for drug use ties (84.1%). These proportions of corroborated ties found were remarkably similar to the numbers reported in another study – Project 90 (Adams & Moody, 2007) – but only after excluding individuals who were not reported within another respondent's network. Project 90 was a study of heterosexuals and people who inject drugs (PWID), which are populations whose networks are substantially distinct from YMSM. For instance, drug networks among PWID often include relatively intimate connections between fellow injectors given the reliance on these networks to obtain drugs and injection paraphernalia (De, Cox, Boivin, Platt, & Jolly, 2007). Thus, one might expect that there would be substantially greater confirmation of ties within a sample of PWID than within this sample of YMSM, as our sample overwhelmingly reported exclusive use of marijuana. Additionally, research suggests that both heterosexuals and PWID tend to report fewer sex partners than MSM (Glick et al., 2012; Hess et al., 2015; Pathela et al., 2011; Spiller et al., 2015); and the more partners one has, the more difficult it is to accurately recall them all within an interview. However, in the case of Project 90, most of the sexual partnerships among heterosexuals were attributed to commercial sex work, and partner number in this sample might be more similar to that of an MSM sample. Regardless, our project's similarity to results within Project 90, at least within the constrained environment of networks that contain both respondents, may speak to the generalizability of our findings. Specifically, if an individual is nominated within a network interview, there is a

high likelihood that reported direct sexual and drug relations are valid, as they would be confirmed by the nominee.

In a minority of instances, N_1 appeared in R_2 's network, but not as a sex or drug partner. One explanation for this could be social desirability. An ego would have no problem listing his family members within the 'closeness' name generator, but might feel uncomfortable saying that he has used drugs with these relatives. Similar reactions could occur when deciding to indicate an alter as a sex partner when there is a differential power dynamic, like a teacher-student relationship. As participants in this study readily reported other socially undesirable behaviors, such as not using condoms during sex, this might not be a major factor in explaining this differential reporting. Additionally, although we hypothesized that timing of the first sex act could play a role in unconfirmed sex ties, there was only one instance in which the first sex act reported by R_1 occurred after R_2 's network interview.

Despite the variability in reporting, we found that stronger relationships and those that had more frequent communication were the most likely ones to validate the existence of a tie. Although this association was not significant for indirect ties, there were clear trends toward significance and large positive effect sizes. Future studies with larger sample sizes will presumably have adequate power to detect these relationships. Similarly, within corroborated ties, both of these factors were associated with accurate reporting of basic demographics. This also highlights some difficulties with ensuring matching responses regarding transgender individuals, who could either identify as transgender or as their current gender identity, and the gender their sex partners perceive them to be. Studies with sexual and gender minority individuals should be careful when comparing known and perceived identities for making matches, and should take into consideration potential overlap in categories.

As we expected, perceived (indirect) ties were not the same as known (direct) ties. Since most prior network research treats these tie types as equivalent in analyses, this encourages researchers to incorporate a new paradigm into their work. Although perceived ties might not be as accurate as known ties, the solution is not to drop them from analysis. These connections are extremely important, both for understanding the overall network structure within communities and for assessing the role that these perceived partnerships could play in individual- and dyadic-level behavior. One possible approach to adjust for this error would be to develop weights to account for the differential accuracy in reports between perceived and known ties. While this could be as simple as weighting perceived ties with half the strength as known ties, we recommend that these weights be informed by additional characteristics, including strength of relationship and frequency of communication. As these characteristics were strong predictors of the presence of corroborated ties, they are vital to interpreting the accuracy of one's network. Alternatively, more sophisticated modeling approaches could be developed that more accurately model error of perceived ties in networks using multiple indicators for relational ties. For example, a method for modeling error in data with multiple reports of ties in whole networks, such as when measuring cognitive social structures (Krackhardt, 1987), has already been developed (Butts, 2003). Future work could generalize these methods to partially overlapping networks, although the value of this approach would likely depend on the extent of overlap within the networks. In

addition, another promising approach could include multilevel exponential random graph models (ERGMs) (Wang, Robins, Pattison, & Lazega, 2013) to systematically account for the nested nature of the observations within respondents at one level, and within nominated persons as the other level. Because multilevel ERGMs allow for ties both between and within levels (i.e., between respondents, between nominated persons, and between respondents and nominated persons), this approach may be more desirable compared with other methods proposed for overlapping egocentric networks, such as multiple membership multiple classification models (Vacca, Stacciarini, & Tranmer, 2016) that are primarily focused on the ties between respondent and nominated persons.

Given previous findings that omission is a major source of error in social network recall generally (Brewer, 2000), and in sexual network recall specifically (Brewer et al., 1999), we speculate that the failure to corroborate ties were likely because R_1 forgot to include R_2 in their network rather than R_1 over reporting sexual ties with R_2 where they did not occur. If this is the case, even without any analytic correction or weighting, omission should not significantly affect the quality of the matched macronetwork dataset if at least one alter reports the relationship. However, this error would be more likely to bias results from egocentric networks, given their reliance on a single report. Unfortunately, this hypothesis cannot be fully evaluated in the current data, and potential reasons for the variable level of corroboration found in the current study clearly remain an area for substantial future work.

Finally, we found differences in tie corroboration between sex and drug networks in this study. Although there were fewer sex ties than drug ties corroborated, this reason for uncorroborated ties substantially differs between these two types of relationships. In the vast majority of cases (93.9% and 97.8%), a sex tie was not corroborated simply because the respondent was not reported in the other respondent's network. However, a smaller proportion of drug ties (86.5% and 78.8%) were not corroborated for this same reason. So, if an individual was reported within the network, they were more likely to be accurately named as a sex partner than as a drug partner. This might be due in part to sex being a rarer occurrence than drug use, and thus people are more likely to remember to include sex partners than drug partners.

Ultimately, the method in which network data are collected can play a substantial role in improving complete and accurate reporting. Traditional approaches, such as the participant-aided sociogram methodology (Hogan et al., 2007) used within this study, require individuals to complete the cognitively difficult tasks of remembering people within their networks and providing descriptive information on them under the guise of low-technology methods. Therefore, new and innovative network data capture methods (Hogan et al., 2016) that are more intuitive and engaging for the participant (and that do not feel like a chore) are likely to facilitate recall and elicitation of alters, and ultimately improve the completeness of captured networks.

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Highlights

- Accuracy of sex and drug tie reporting was assessed within a sample of YMSM.
- Most ties were not corroborated because the nominee was not in the respondent's network.
- Stronger relationships significantly predicted reciprocated sex and drug ties.
- Direct and indirect ties need to be treated differently in network analysis.

(a)

(b)

Figure 1. Examples of direct tie reporting

Note. Rs represent respondents who completed an egocentric interview. Ns represent nominated alters who did not completed an egocentric interview. Solid lines represent directly reported ties.

Figure 2. Examples of indirect tie reporting

Note. Rs represent respondents who completed an egocentric interview. Ns represent nominated alters who did not completed an egocentric interview. Solid lines represent directly reported ties while dotted lines represent an indirectly reported tie (i.e., between two nominated individuals that were not respondents).

Table 1
Direct and indirect tie corroboration within sex and drug networks of young men who
have sex with men in Chicago

	Sex Ties		Drug Ties	
	n	%	n	%
Direct tie corroboration				
Unique ties	49		89	
R_2 in R_1 's network	18	36.7	44	49.4
Corroborated	16	88.9	37	84.1
Uncorroborated	2	11.1	7	15.9
R_2 not in R_1 's network	31	63.3	45	50.6
Indirect tie corroboration				
Unique ties	67		52	
N_1 in R_2 's network	23	34.3	26	50.0
Corroborated	22	95.7	19	73.1
Uncorroborated	1	4.3	7	26.9
N_1 not in R_2 's network	44	65.7	26	50.0

Table 2
Odds ratios for predictors of direct and indirect tie corroboration within sex and drug networks of young men who have sex with men in Chicago

	Sex Ties		Drug Ties	
	OR	95% CI	OR	95% CI
Direct tie corroboration				
Frequency of communication ^a	1.81	1.17, 3.14	1.73	1.20, 2.66
Relationship strength ^b	3.73	1.55, 11.05	1.87	0.97, 3.84
Indirect tie corroboration				
R ₁ -R ₂				
Frequency of communication	1.60	0.97, 2.98	1.66	0.98, 3.27
Relationship strength	1.45	0.70, 3.30	1.90	0.80, 5.37
R ₁ -N ₁				
Frequency of communication	1.03	0.75, 1.44	0.81	0.41, 1.54
Relationship strength	0.84	0.44, 1.57	1.05	0.75, 1.50

^aResponse options ranged from 0 = *Not at all* to 5 = *Daily*

^bResponse options ranged from 1 = *Very close* to 3 = *Not at all close*