Social Networks of Drug Users: Extension of Weeks et al. (2002) to Other Settings

Social Network Analysis Final Paper

Jhony Pulido

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1 Background: original study

Weeks et al. (2002) used social network analysis "*to explore the relationships and interactions of drug users in settings in which potential risk occurs, and to assess the opportunity to create prevention linkages*" (page 193).

They sampled 293 drug-users in high-risk sites in Hartford, Connecticut, between 1998 and 1999. 55% were recruited through community outreach targeting neighborhoods with high drug presence. The remaining 45% through a respondent-driven sampling process which consisted on using monetary incentives to motivate the already-sampled individuals to invite other familiar people to the study. Every participant had to comply with the two following eligibility criteria: being at least 18 years-old and having actively consumed a hard drug (such as heroin, cocaine, or crack) during the 30 days before the study began.

The authors combined an ethnographic approach with epidemiological and social surveys to gather information about each participant and their network. The epidemiological sections asked for factors such as drug use, HIV status, risky practices, among others. Meanwhile, the social network part emphasized on personal characteristics of the alter nodes (e.g. whether they are also drug users) and information about the ties (like the duration and strength of the relationship and frequency of interaction). Ties were limited to people with whom participants had at least one interaction during the past six months, and respondents could include in their networks up to a total of 16 alters. It was intended in the study that each participant answered the survey three times in a six-month period.

This research performed two main approaches. First, the authors undertook an ego-network comparison to

observe if there were differences on individuals' networks composition and dynamics based on the ego-nodes' ethnicity (African American, Puerto Rican, and White) and sex. In this analysis, each unit was a network and comparisons consisted on conventional mean or proportion subgroup differences on relevant variables such as network size, the prevalance of drug users, and tie strength. Secondly, they moved to a whole-network analysis to analyze the presence of clusters based on the same two characteristics (ethnicity and sex) using visual representations of the network. They limited this exercise to the largest component of a network conformed only by those individuals who were sampled to participate in the study, leading to the inclusion of 193 out of the 293 respondents. It is worth pointing out that ties among study participants were verified by the research team through ethnographic field observations and interviews.

Through these analyses, the authors found that both ethnicity and sex seemed to be relevant factors for network composition and dynamics. For instance, African American ego-networks were, on average, larger (both overall and only considering drug users) and have older ties than Puerto Ricans. Nevertheless, Puerto Rican networks were stronger and had a higher frequency of interaction. Additionally, the network visualization allowed to observe three clearly defined clusters based on ethnicity, meaning that drug users had very low levels of interactions with others outside their ethnic group. Besides, a second visualization based on sex suggested that men have, on average, much higher levels of centrality than women, who tended more to be in the peripheries of the sub-networks. Figures 1 and 2 show the authors' results using their original figures.

2 The paper

2.1 Motivation

Based on their results, Weeks et al. (2002) claimed the following: "*with knowledge of social ties and structural linkages among drug users, we can begin to move beyond individual-centered, behavioristic explanations of HIV risk, transmission, prevalence, and formulas for prevention*" (page 204). What the authors referred to with this indication is that social structures matter and should be considered when designing interventions aiming to overcome a social problem, whether it is HIV transmission, drug use, or any other. Therefore, generating evidence over networks and social structures related to drug use in settings similar to that studied by these authors might contribute to the policy debate around this topic and move away from "one-size-fits-all" interventions.

Nevertheless, it is not the intention of this final paper to come with an accurate description about the most relevant factors affecting how drug users interact with each other and form networks.

Figure 1: Ethnicity-based clustering in drug users network

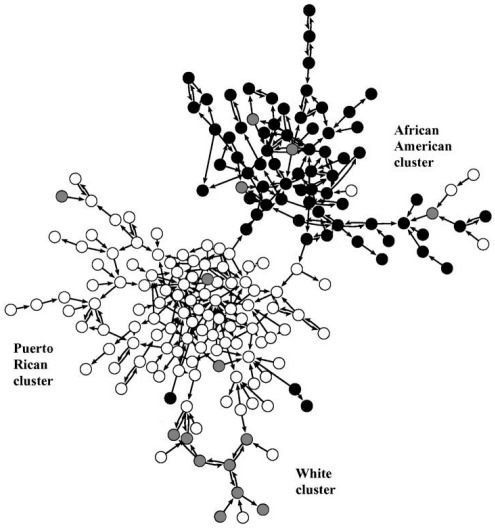


Fig. 1. HRS study macro-network largest connected component by ethnicity. Total $n = 193$: ●, African Americans ($n = 70$); ○, Puerto Ricans ($n = 109$); ◍, Whites/others ($n = 14$).

Source: Figure 1 from Weeks et al. (2002) (page 200)

Figure 2: Location of men and women in drug users network

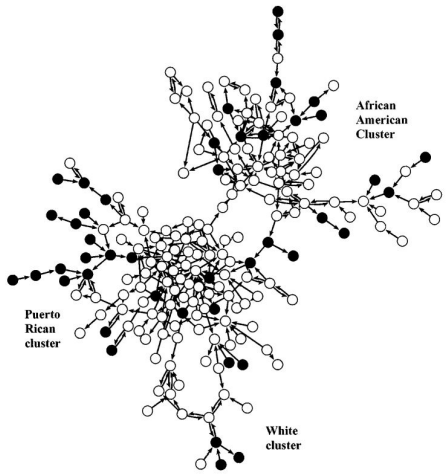


Fig. 2. HRS study macro-network largest connected component by gender. Total $n = 193$: ●, Men ($n = 148$); ○, Women ($n = 45$).

Source: Figure 2 from Weeks et al. (2002) (page 201)

Our intention is by far more simple: just to keep emphasizing that we as social scientists, policy analysts and policymakers must always remember that human experiences are shaped by contexts and contexts can differ between groups based on their characteristics.

Finally, in the particular case of sex and ethnicity, generating more evidence about their relationships in drug user networks can also motivate further and deeper research other this topic with the aim of understanding better the mechanisms through which such characteristics can end up affecting the way individuals experience their drug use-related reality.

2.2 Data

This work uses a dataset from Morris and Rothenberg (2011), which contains several high-risk drug user networks between 1997 and 2001 in different places in the United States. The following table details the networks included in this paper.[1]

Table 1: Drug user networks analyzed in this paper

Setting	Number of ego-nodes	Ego-nodes with drug-related ties
Atlanta Antiviral	358	216
Atlanta Urban	228	210
Baltimore	1,667	1,371
Brooklyn	703	312
Colorado Springs	591	440
Flagstaff Rural (Arizona)	88	69
Houston	295	237
Total number of ego-nodes	3,923	2,855

Note: this paper uses the number of ego-nodes displayed in the third column. **Source:** Morris and Rothenberg (2011) except the third column, which is based on own calculations

Each setting is represented by an edge list connecting each ego-node to the alters he or she included as part of their network. We kept the following information in every setting:

- Ego-node ethinicity: we defined the following categories based on the data

[1] We excluded one setting because it was located outside the United States: Manitoba, Canada.

  - African American: those who identified their race as "Black" and their ethnicity as "Non-hispanic"
  - White: those those who identified their race as "White" and their ethnicity as "Non-hispanic"
  - Latino/hispanic: those who identified their ethnicity as "Hispanic," regardless of their race
  - Others: those who did not identified their race as "White" or "Black" and identified their ethnicity as "Non-hispanic"
- Ego-node sex: male or female
- Type of tie: sexual, social, drug use, or others. The drug use category was further divided into "needle sharing" and "other drugs."

Additionally, any tie can appear more than once in a setting based on the following conditions:

- Number of interviews: being all settings part of longitudinal studies, each ego-node may have been interviewed more than once
- Type of relationship: an ego and alter node may have shared more than one type of relationship (e.g. both a drug and social relationship during the same period)

There were other variables that would have been informative for this paper. However, they were discarded for not being available in every setting.[2]

2.3 Analytical strategy

This paper follows the methodological approach used by Weeks et al. (2002). We used as inputs the data sets harmonized by Morris and Rothenberg (2011) to construct a separate set of ego-networks and a whole-networks in each setting.

We constructed ego-networks by aggregating the information related to the ties held by each respondent, so that each observation corresponded to an ego-node. Considering the objective of this paper, the samples in each setting only included those respondents with at least one drug-related tie (see third column of Table 1). Afterwards, we performed sub-groups mean comparisons based on ethnicity and sex in each setting using t-tests to calculate the statistical significance of the differences. Then, we generated one whole-network for each setting using the ties among the study participants and plotted the largest component(s). We discarded ties that included alters that were not part of the sample because not all settings gathered race and ethnic information from those individuals. Thus, we only have this information for the ego-based nodes.

[2]For instance, some settings gathered information about employment status, occupational prestige and activities, and educational attainment of ego and alter nodes.

When performing analysis based on ethnicity, we dropped the information related to other ethnicities different from White, African American, and Hispanic. This decision answered to the fact that, in contrast to Weeks et al. (2002), our data sets included other minority ethnic groups such as Native Americans and Asians. Including these groups would have hindered the analysis because they do not appear in every setting and are considerably underrepresented in some of the settings in which they are included. Moreover, aggregating them in a category such as "Others" would have not added value to this work because each group might have probably different dynamics. Thus, it would have been afterwards difficult interpreting the results of such a category. Such exclusions are not performed on analysis based on sex.

2.4 Results

2.4.1 Ethnic-based differences in the composition of ego-networks

Table 2 shows the results of the mean differences on network size. We can observe the average network size was normally above 10 people except in the case of Houston and Brooklyn. The notoriously smaller sizes in this last setting might suggest that these participants may not be that comparable to the rest. The other settings, including Houston, showed average ego-networks larger than those reported by Weeks et al. (2002).[3] There is no clear pattern emerging about network size and few significant differences. For instance, while African Americans and Hispanics had, on average, a higher network size than Whites in Baltimore, the opposite happens in Urban Atlanta and Flagstaff. Perhaps what seems to be more consistent is the fact that differences between African Americans and Hispanics are commonly smaller.

Differences regarding the prevalence of drug users in ego-networks are displayed in Table 3. The average respondent in all settings held a proportion of drug-related relationships considerably lower than those observed in Weeks et al. (2002) (which were between 80% and 88%). In this sense, the respondents belonging to that work might have been potentially exposed to more risks related to drug use since their networks were mostly composed by other drug users. This table also shows small ethnic-based differences in drug-related ties with the exceptions of larger negative differences for African American in Baltimore. It is worth mentioning that although Hispanics had a much lower share of drug user in their networks in Atlanta Antiviral, this results should be interpreted cautiously given that the number of Hispanics in this setting was very low. Therefore, it seems that in these settings ethnicity was less of a relevant factor for explaining differences in maintaining drug-related ties.

[3]Those authors reported an average network size of 7.4 for African Americans and 4.4 for Puerto Ricans

Table 2: Ethnicity-based differences in mean network size

	Atlanta (Antiviral)	Atlanta (Urban)	Baltimore	Brooklyn	Colorado Springs	Flagstaff (AZ)	Houston
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
African American	1.267	−2.731	2.898***	−0.339	2.796*	−2.602	0.822
	(1.454)	(3.431)	(0.987)	(0.420)	(1.625)	(1.632)	(0.766)
Hispanic	−1.375	−2.571	4.323	0.156	−0.368	−3.008	−1.722**
	(4.940)	(7.155)	(3.269)	(0.401)	(1.632)	(2.619)	(0.858)
Constant	10.375***	15.571***	12.077***	4.779***	16.960***	14.579***	9.254***
	(1.370)	(3.373)	(0.968)	(0.281)	(0.776)	(1.359)	(0.600)
Observations	216	210	1,371	312	440	69	237
F Statistic	0.517	0.317	4.429**	0.701	1.681	1.401	5.377***

Note: Groups' coefficients show mean differences with respect to the 'White' group (whose mean value is reflected in the constant term). $^{*}p < 0.1,^{**}p < 0.05,^{***}p < 0.01$.

Table 3: Ethnicity-based differences in percentage of drug-related ties inside ego-networks

	Atlanta (Antiviral)	Atlanta (Urban)	Baltimore	Brooklyn	Colorado Springs	Flagstaff (AZ)	Houston
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
African American	−0.046	0.056	−0.083***	0.010	−0.018	−0.044	−0.053
	(0.053)	(0.088)	(0.023)	(0.020)	(0.026)	(0.069)	(0.035)
Hispanic	−0.297	0.006	0.059	−0.004	0.006	−0.063	−0.048
	(0.182)	(0.183)	(0.076)	(0.019)	(0.027)	(0.110)	(0.040)
Constant	0.371***	0.508***	0.394***	0.343***	0.366***	0.590***	0.552***
	(0.050)	(0.086)	(0.022)	(0.013)	(0.013)	(0.057)	(0.028)
Observations	216	210	1,371	312	440	69	237
F Statistic	1.442	0.248	8.358***	0.276	0.321	0.257	1.233

Note: Groups' coefficients show mean differences with respect to the 'White' group (whose mean value is reflected in the constant term). $^{*}p < 0.1,^{**}p < 0.05,^{***}p < 0.01$.

Table 4 focuses on drug-related ties limited to needle sharing, which is a relevant aspect considering how this activity might create additional risks for drug users related to the potential transmission of diseases such as HIV. This table shows several remarks. On one side, shares differ widely across settings. For instance, both studies in Atlanta and Flagstaff had considerably low proportions of needle sharing (less than 4%), despite having relatively high prevalence of drug ties. Meanwhile, Brooklyn, Baltimore, and Houston showed remarkably greater proportions of needle sharing. Brooklyn's case is specially worth highlighting not only because it at least almost doubled the prevalence of the other settings, but also because most of its drug-related ties are connected to needle sharing. Adding this point to the starkly smaller network size observed in Table 2 helps build the case that Brooklyn's study might have targeted a different type of people

in comparison to the other settings.

We can also appreciate from this table that, in comparison to other groups, African Americans seem to have a lower propensity to engage in (or at least report) needle sharing activities in settings with relatively high prevalence of such ties except in the case of Brooklyn. Moreover, their shares are 5% or lower in all settings except Baltimore and Brooklyn. Therefore, their drug-related problems seem to be in most caes concentrated in other drugs. In contrast, this is not true for Hispanics and Whites. In places where needle sharing was more common, their proportions where significantly higher and similar to each other.

Table 4: Ethnicity-based differences in percentage of needle-sharing ties inside ego-networks

	Atlanta (Antiviral)	Atlanta (Urban)	Baltimore	Brooklyn	Colorado Springs	Flagstaff (AZ)	Houston
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
African American	−0.010	0.0003	−0.073**	0.012	−0.167***	−0.038**	−0.368***
	(0.014)	(0.040)	(0.029)	(0.041)	(0.031)	(0.015)	(0.041)
Hispanic	−0.021	−0.022	0.052	0.024	0.019	−0.007	−0.066
	(0.047)	(0.083)	(0.097)	(0.039)	(0.031)	(0.024)	(0.046)
Others	0.021	0.022	0.407***	0.730***	0.213***	0.038***	0.421***
	(0.013)	(0.039)	(0.029)	(0.027)	(0.015)	(0.012)	(0.032)
Observations	216	210	1,371	312	440	69	237
F Statistic	0.290	0.046	3.985**	0.197	16.785***	3.775**	49.282***

Note: Groups' coefficients show mean differences with respect to the 'White' group (whose mean value is reflected in the constant term). $^{*}p < 0.1$,$^{**}p < 0.05$,$^{***}p < 0.01$.

Finally, 5 displays differences in the proportion of sexual ties. Looking at this type of ties is also important because, like needle sharing, they are also related to higher risks of acquiring sexual transmitted diseases. Therefore, having both high a prevalence of needle sharing and sexual ties can suggest that individuals are exposed to relevant levels of risk and could also act as spreaders. Once again, we can observe heterogeneity in the prevalence of this type of tie based on the setting being observed, with Atlanta having much higher shares than the rest. There are no clear ethnicity-based differences except for a couple of exceptions. African Americans have a much lower prevalence of sexual ties in Urban Atlanta and a higher prevalence in Colorado Springs in comparison to Whites and Hispanics. Meanwhile, Hispanics have a lower share of such ties in Atlanta (Antiviral) and a higher proportion in Brooklyn in comparison to Whites.

Table 5: Ethnicity-based differences in percentage of sexual ties inside ego-networks

	Atlanta (Antiviral)	Atlanta (Urban)	Baltimore	Brooklyn	Colorado Springs	Flagstaff (AZ)	Houston
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
African American	−0.098	−0.270***	−0.005	0.007	0.118***	−0.006	0.017
	(0.060)	(0.086)	(0.015)	(0.044)	(0.028)	(0.051)	(0.033)
Hispanic	−0.199	0.048	−0.033	0.104**	−0.022	0.041	−0.023
	(0.203)	(0.180)	(0.049)	(0.042)	(0.029)	(0.082)	(0.037)
Others	0.421***	0.528***	0.136***	0.184***	0.324***	0.190***	0.249***
	(0.056)	(0.085)	(0.014)	(0.029)	(0.014)	(0.042)	(0.026)
Observations	216	210	1,371	312	440	69	237
F Statistic	1.509	6.810***	0.240	3.693**	10.214***	0.196	0.684

Note: Groups' coefficients show mean differences with respect to the 'White' group (whose mean value is reflected in the constant term). $^{*}p < 0.1$,$^{**}p < 0.05$,$^{***}p < 0.01$.

2.4.2 Sex-based differences in the composition of ego-networks

Tables 6, 7, 8, and 9 repeat the exercises focusing on sex. Like in Weeks et al. (2002), women in these settings tend to have, on average, similar size networks than men, with the only noteworthy difference being in Colorado Springs, where their networks tended to be smaller. Nevertheless, they showed consistently a larger predominance of relationships based on drug use than men (see Table 7), and had a statistically higher tendency to share needles in Colorado Springs (Table 8). Finally, women showed a similar proportion of sexual ties than men with the exception of two settings: Brooklyn and Colorado Springs, settings in which their percentages were smaller. It is worth mentioning that we are deliberately moving attention away from the significant results in Baltimore because they are being driven by a higher statistical power due to much greater sample size than by an economically relevant magnitude of its coefficients.

Table 6: Sex-based differences in mean network size

	Atlanta (Antiviral)	Atlanta (Urban)	Baltimore	Brooklyn	Colorado Springs	Flagstaff (AZ)	Houston
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Females	−0.779	0.553	−0.982**	0.175	−4.484***	−1.930	−0.600
	(0.963)	(1.250)	(0.381)	(0.309)	(1.193)	(1.308)	(0.683)
Constant	12.078***	12.646***	15.424***	4.538***	19.611***	13.286***	9.549***
	(0.777)	(0.994)	(0.297)	(0.282)	(0.842)	(0.981)	(0.552)
Observations	221	215	1,408	621	456	80	237
F Statistic	0.655	0.196	6.647**	0.321	14.129***	2.177	0.773

Note: Females' coefficients shows mean differences with respect to males (whose mean (value is reflected in the constant term). $^{*}p < 0.1$,$^{**}p < 0.05$,$^{***}p < 0.01$.

Table 7: Sex-based differences in percentage of drug-related ties inside ego-networks

	Atlanta (Antiviral)	Atlanta (Urban)	Baltimore	Brooklyn	Colorado Springs	Flagstaff (AZ)	Houston
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Females	0.069**	0.007	0.019**	0.031**	0.044**	0.100*	0.050
	(0.035)	(0.032)	(0.009)	(0.015)	(0.020)	(0.055)	(0.031)
Constant	0.279***	0.560***	0.304***	0.323***	0.339***	0.503***	0.482***
	(0.028)	(0.026)	(0.007)	(0.014)	(0.014)	(0.042)	(0.025)
Observations	221	215	1,408	621	456	80	237
F Statistic	3.980**	0.044	4.516**	4.122**	5.008**	3.237*	2.601

Note: Females' coefficients shows mean differences with respect to males (whose mean (value is reflected in the constant term). $^{*}p < 0.1,^{**} p < 0.05,^{***} p < 0.01$.

Table 8: Sex-based differences in percentage of needle-sharing ties inside ego-networks

	Atlanta (Antiviral)	Atlanta (Urban)	Baltimore	Brooklyn	Colorado Springs	Flagstaff (AZ)	Houston
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Females	−0.001	0.013	0.023**	0.015	0.051**	−0.016	0.063
	(0.009)	(0.014)	(0.011)	(0.031)	(0.023)	(0.012)	(0.042)
Constant	0.012*	0.013	0.323***	0.728***	0.157***	0.021**	0.197***
	(0.007)	(0.011)	(0.009)	(0.028)	(0.016)	(0.009)	(0.034)
Observations	221	215	1,408	621	456	80	237
F Statistic	0.012	0.794	4.048**	0.235	4.843**	1.860	2.242

Note: Females' coefficients shows mean differences with respect to males (whose mean (value is reflected in the constant term). $^{*}p < 0.1,^{**} p < 0.05,^{***} p < 0.01$.

Table 9: Sex-based differences in percentage of sexual ties inside ego-networks

	Atlanta (Antiviral)	Atlanta (Urban)	Baltimore	Brooklyn	Colorado Springs	Flagstaff (AZ)	Houston
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Females	0.060	−0.036	0.018***	−0.119***	−0.050**	0.001	−0.028
	(0.039)	(0.032)	(0.006)	(0.030)	(0.022)	(0.040)	(0.029)
Constant	0.296***	0.295***	0.121***	0.296***	0.371***	0.186***	0.268***
	(0.031)	(0.026)	(0.004)	(0.028)	(0.015)	(0.030)	(0.024)
Observations	221	215	1,408	621	456	80	237
F Statistic	2.404	1.228	9.536***	15.434***	5.255**	0.001	0.931

Note: Females' coefficients shows mean differences with respect to males (whose mean (value is reflected in the constant term). $^{*}p < 0.1,^{**} p < 0.05,^{***} p < 0.01$.

2.4.3 Ethnic-based clustering patterns in whole-networks

Figures 3 to 6 display the largest network components of Brooklyn, Colorado Springs, Flagstoff, and Houston.[4] It is worth mentioning that we kept only one component in the first three settings and five in Houston. The reason for this decision is that Houston was the only setting that had more than one component concentrating a relevant share of the network.[5]

A general overview of the figures allows to observe some clustering patterns related to ethnicity that are similar to those found in Weeks et al. (2002) (see Figure 1). There do not seem to be three clearly-defined clusters in Brooklyn, but several smaller clusters instead. However, we do observe in Figure 3 very low between-ethnic groups interactions, especially involving White and African Americans. These two groups are normally located at the peripheries of the network. Hispanics, in contrast, seem to have a more central location and higher interactions with other groups. We also observed an ethnic concentration in Colorado Springs, with almost all African Americans being located at the left side of the network and Hispanics at the center (see Figure 4). Although there are also concentrations of almost only white people in the right side of the network, we do observe some interaction between White and Hispanics and Whites and African Americans. There are more clear-cut patterns in Flagstoff (Figure 5) and Houston (Figure 6) with most people being almost only tied with others belonging to their own ethnicity.

[4]This section excludes the Baltimore and both Atlanta settings because they would not have added to the analysis. Baltimore's network is highly disaggregated and had very few ties between respondents. To clarify this, Figure A1 in the appendix shows the components' distribution of this network. As it can be appreciated, the largest component had only 6 ties. On the other side, nodes belonging to Atlanta (Antiviral) had no ties among each other (see Figure A2). Finally, Atlanta (Urban)'s largest component had an enormous concentration of African American nodes (see Figure A3).

[5]In the other three cases, the number of nodes included in a component dropped dramatically when moving from the largest to the second largest component. For example, while the largest component in Colorado Springs included 270 nodes, the next component had barely 3. In contrast, Houston's largest component had 51 nodes, the following had 39, the third had 25, and the fourth and fifth had 9.

Figure 3: Ethnicity-based clustering in drug users network. Brooklyn

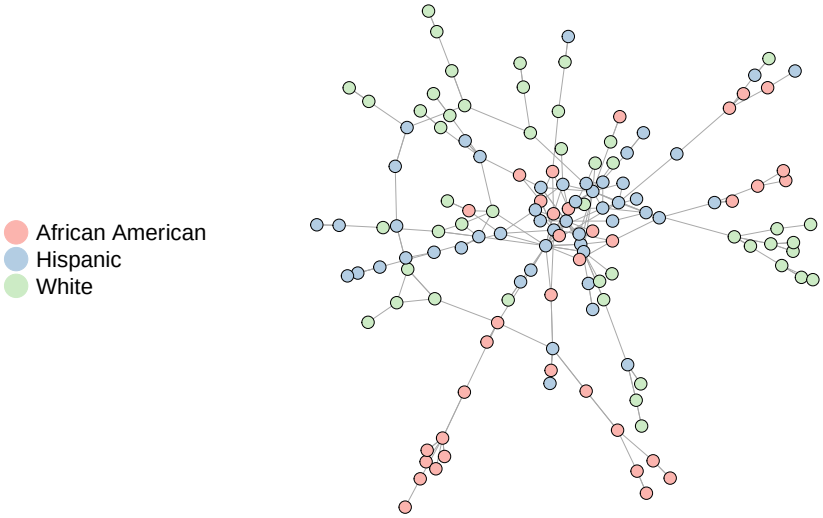


Figure 4: Ethnicity-based clustering in drug users network. Colorado Springs

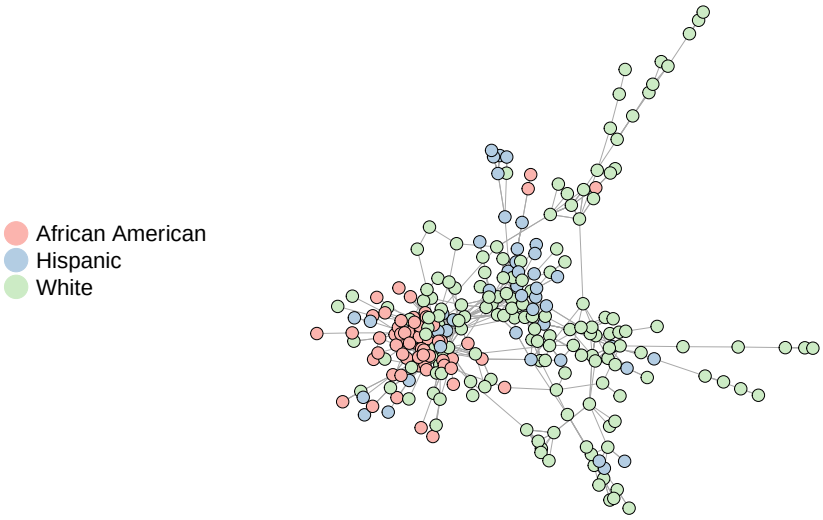
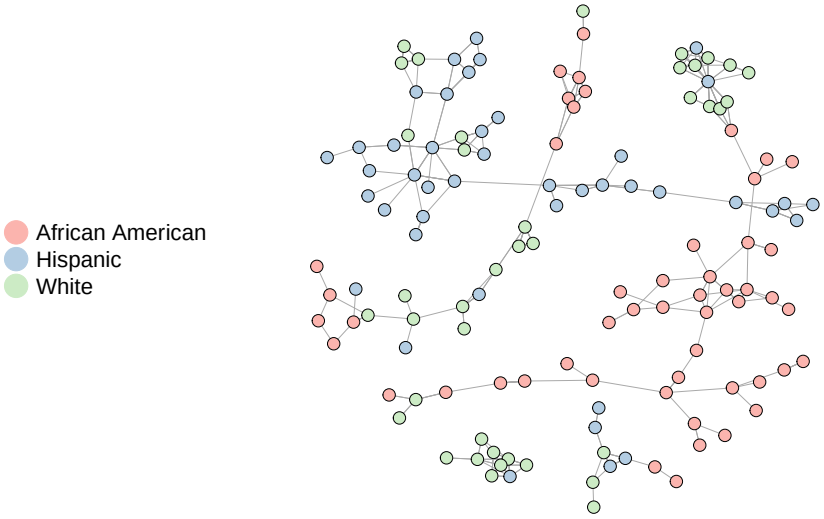


Figure 5: Ethnicity-based clustering in drug users network. Flagstoff (Arizona)

Figure 6: Ethnicity-based clustering in drug users network. Houston



2.4.4 Sex-based clustering patterns in whole-networks

Figures 7 to 11 show the same visualizations but using sex instead of ethnicity to differentiate among nodes. In this occasion, we included the Atlanta (Urban) setting because both males and females were represented in proportions adequate enough to show any patterns. In contrast to analysis based on ethnicity, the exercises performed in this section do not find results similar to Weeks et al. (2002) (see Figure 2). Neither men nor women seemed to have, one average, a particularly peripherical position in any setting. Atlanta (Urban)'s network contains several small clusters, some with males having a more central positions and others with females more in the center (Figure 7). It is interesting, however, that female nodes tend to act as bridges between clusters more frequently than men. On other side, females tend to be located more in the center in Brooklyn despite being considerably less in numbers than men (Figure 8). In Colorado Springs (Figure 9) and Flagstoff (Figure 10, males might have a slightly higher centrality, but differences do not seem clear. Finally, there do not seem to be sex-based differences in Houston (Figure 11).

Figure 7: Sex-based clustering in drug users network. Atlanta (Urban)

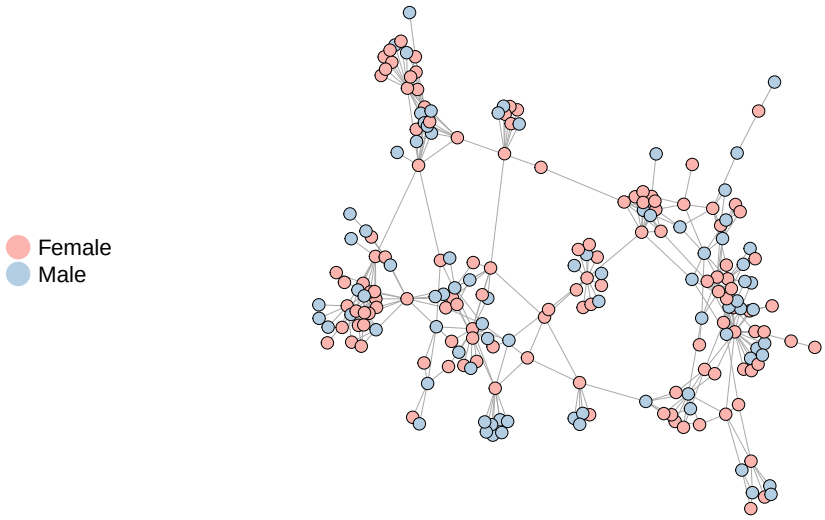


Figure 8: Sex-based clustering in drug users network. Brooklyn

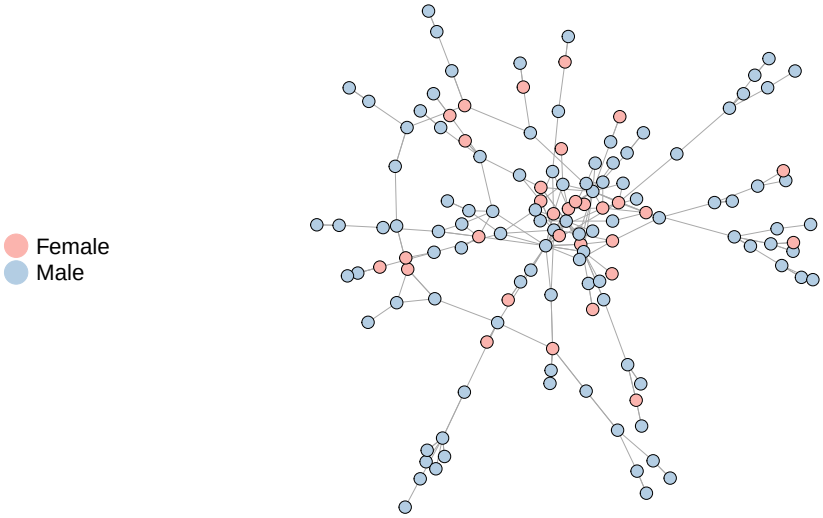


Figure 9: Sex-based clustering in drug users network. Colorado Springs

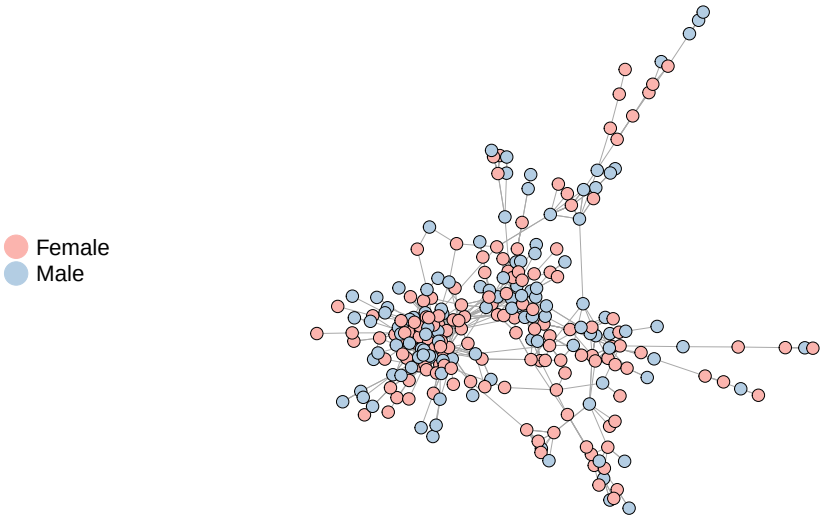


Figure 10: Sex-based clustering in drug users network. Flagstoff (Arizona)

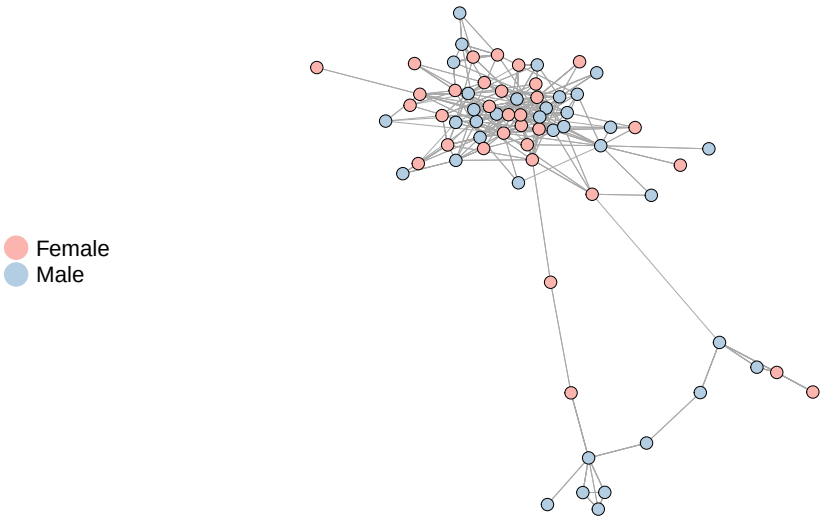
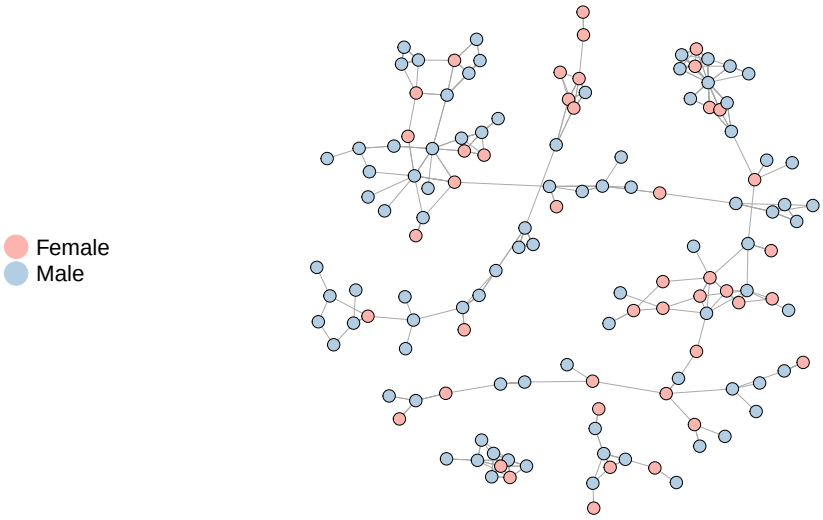


Figure 11: Sex-based clustering in drug users network. Houston



2.5 Discussion and limitations

This paper utilized the approach followed by Weeks et al. (2002) to study ethnic related difference in drug users' network structure and dynamics. In comparison to that work, we found much less between-group differences in ego-networks, which suggests that in these settings ethnicity may have been less of a relevant factor for explaining the composition of drug users' networks. However, the fact that respondents included in Weeks et al. (2002) had much higher proportions of drug-related ties might be indicative that those individuals might have been in a more serious and harmful situation regarding drug consumption. A counter-argument to this point could be that respondents in that particular setting may have had higher shares of drug-related ties simply because their network sizes were, on average, smaller. Nevertheless, the differences in network size do not seem to be associated with different limitations for reporting alter nodes since Weeks et al. (2002) allowed up to fifteen names per ego-node, which is significantly higher than the average number of ties reported by each participant. Therefore, respondents in Weeks et al. (2002) may have listed less alter nodes just because their networks were, in fact, smaller, which is something that could be related to the influence of drug use. In this sense, ethnic can perhaps play a major role in shaping networks in which hard drugs are more present.

The only ethnic-related pattern we observed in our data was a much lower propensity of African Americans to engage in needle-sharing ties despite having commonly a similar prevalence of drug-related connections. This could be a consequence of under-reporting such ties (potentially due to issues related to mistrust) or it could be signalling that African Americans might be facing problems with other type of drugs. We cannot compare this result to Weeks et al. (2002) because they did not differentiate between different drugs. However, if it does not answer to issues of reporting, it could already mean that the experience of these African Americans using drugs could be different from the rest. On one side, they might have been less exposed to contracting diseases via needle-sharing. On the other side, however, consuming other drugs may also bring other type of problems. In any case, these differences also mean that intents to support them to withdraw from this activity may need to some extent to differ.

We did find more similar patterns to Weeks et al. (2002) when looking at whole networks. Like these authors pointed out, respondents had a higher tendency of keeping drug-related ties with other drug users from their same ethnic group. Therefore, despite the lack of patterns coming from the ego-network analysis, ethnicity does seem to influence the dynamics (and composition to some extent) of networks. Whether this impacts the way respondents experience drug use and acts as a barrier or enabler for policies looking to reduce drug consumption is something that this paper could not explore. It remains being a topic that should be analyzed with more details by future studies. Despite this lack of more detailed knowledge, taking ethnicity into account seems advisable when designing policy interventions in this area. In this sense, these results back

Weeks et al. (2002) claims regarding the importance of "*ethnic–cultural appropriateness of messages and messengers to increase the likelihood that prevention information, materials, and practices will be accepted, adopted, and promoted within the network*" (page 203)

Regarding sex, we found that women had consistently a somewhat higher prevalence of drug-related ties than men despite having similar network sizes. This might make them a more vulnerable subgroup if we assume that a higher proportion of drug relationships can act as a barrier to stop drug consumption. Future research should focus on learning more about this aspect. Weeks et al. (2002) did not observe such a result, although this might be related, once again, to the differences in the situation of drug users between both studies. In this sense, the respondents from the original study might have lacked the capability of keeping ties with several non-drug users because they might have been already deeply immersed into drug consumption. Additionally, we did not find the discrepancies in the levels of centrality that were present in Hartford, as in our settings men and women were similarly connected to other nodes. A potential policy implication of these results is that women in our settings do not seem to be hardly reachable.

This paper has several limitations worth considering. In the first place, it shares the drawbacks of most social network studies regarding their capability of extrapolating results to the analyzed settings since they utilize convenient sampling methods instead of probabilistic. Nevertheless, in the absence of an adequate sampling frame for the population under study, achieving representative samples might always be unfeasible. A second layer of challenges related to the samples arise from the fact that every setting adopted different approaches to generate their purposeful samples since they were not initially part of the same research project. For instance, the Houston setting combined random walks and different recruitment methods (like matching and peer-driven) while Flagstaff used only random walks (Morris and Rothenberg (2011)). Such discrepancies make it difficult to even make between setting comparisons.

Additionally, our analysis were limited by data availability constraints. On one side, the decision of incorporating several settings in order to look for patterns obliged us to discard any information that was not present in all data sets. For example, some networks had information about occupations and education that might have been useful. On the other, all data sets lacked anyway relevant information to understand network ties. For instance, in contrast to Weeks et al. (2002), none measured the strength and intensity of the ties. Including these variables together with other elements can help understand the role of drug user's network on his or her experience with drug consumption. We are however aware about the trade-offs between including more detailed network information and aspects such as attrition and error measurement due to cognitive fatigue. Thus, survey designers need to be selective when creating drug network surveys. In this sense, it might be advisable to first generate information using in-depth interviews with a reduced number of

drug users and then incorporate it in the questionnaire design.

Finally, this paper did not incorporate in the analysis any information about the settings that could also help make sense of the results. Weeks et al. (2002) did use contextual information in their work. For instance, they associated the greater size and duration of African American ego-networks in Hartford to the historical migration moves that happened during the third and fourth decade of the past century. However, performing such an analysis in our case was challenging considering the multiplicity of settings included in the paper. Therefore, future research using also Morris and Rothenberg (2011) data set but focusing on only one setting can benefit from being able to incorporate more variables as well as contextual information.

3 References:

Morris, Martina, and Richard Rothenberg. 2011. "HIV Transmission Network Metastudy Project: An Archive of Data From Eight Network Studies, 1988–2001." ICPSR - Interuniversity Consortium for Political; Social Research. https://doi.org/10.3886/ICPSR22140.V1.

Weeks, Margaret R., Scott Clair, Stephen P. Borgatti, Kim Radda, and Jean J. Schensul. 2002. *AIDS and Behavior* 6 (2): 193–206. https://doi.org/10.1023/a:1015457400897.

4 Appendix:

4.1 Figures

Figure A1: Components' size distribution. Baltimore

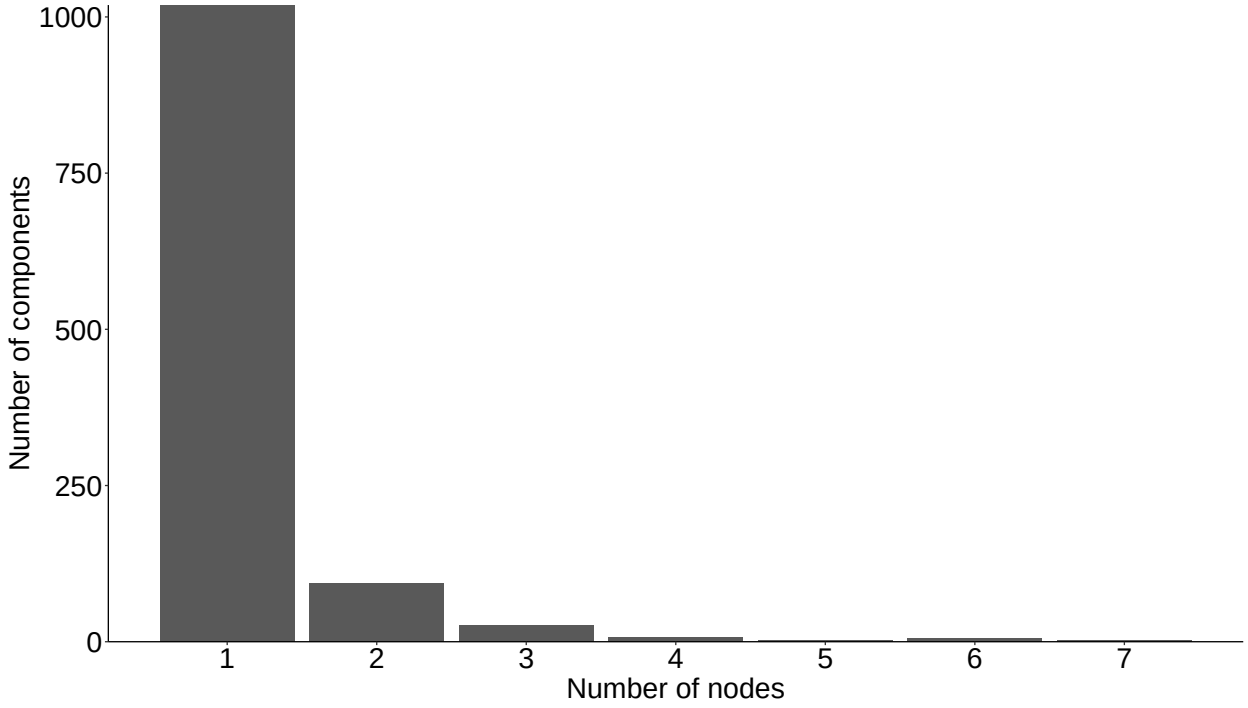


Figure A2: Whole network. Atlanta (Antiviral)

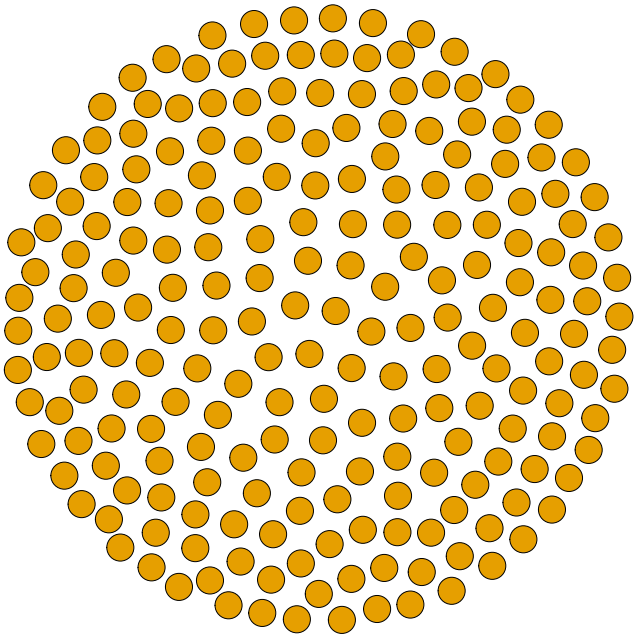


Figure A3: Ethnicity-based clustering in drug users network. Atlanta (Urban)