Finding and Keeping Friends in College and their Influence on Alcohol Use: A Network Analysis

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9-24-2020

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Abstract

Objective. We investigate how alcohol use and friendship co-evolve during students' transition to university. We discern effects of peer influence from friend selection based on alcohol use, whether such effects vary in strength across the school year, and whether alcohol has different effects on friendship formation versus friendship maintenance.

Method. We gathered data on friendships, alcohol use, and binge drinking from 300 residence hall students (71% female) at a large, public U.S. university. Surveys were conducted at four time points during the 2015-16 academic year. We used a stochastic actor-oriented model (SAOM) to test whether alcohol use was influenced by one's friends, while simultaneously testing for friend selection based on alcohol use and related network processes.

Results. Students were 7.0 times more likely to drink alcohol weekly if all vs. none of their friends drank weekly, and 6.8 times more likely to binge drink when all vs. none of their friends engaged in binge drinking, after controlling for friend selection. Alcohol use differentially affected friendship creation and maintenance in a complex manner (1) weekly drinkers were more likely to form new friendships and dissolve existing friendships than non-drinkers; and (2) similarity on drinking fostered new friendships, but had no effect on friendship persistence.

Conclusions. Friends influence one another's weekly drinking and binge drinking, while conversely, alcohol use contributes to both friendship formation and friendship instability.

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Emerging adulthood represents the confluence of several factors amplifying the risk for substance use (Arnett, 2005; White et al., 2005). Millions of young adults enter college each year, at which point alcohol use tends to increase from high school levels (Borsari et al., 2007). In 2016, more than half of college students reported drinking in the past month, of whom two-thirds reported binge drinking at least once (SAMSHA, 2016). First-year students experience higher rates of common alcohol-related problems (e.g., trouble with police, injuries, death) relative to upperclassmen (Borsari et al., 2007), pointing to the first year as a time of heightened risk and a critical period for establishing alcohol-related expectations and behavior.

Two aspects of the transition from high school to university are noteworthy. First is the abrupt changes in one's physical, institutional, and social environment. Students enter a new context filled with uncertainties regarding norms and expectations, while experiencing upheaval in their support networks (Compas et al., 1986). One first-year student characterized this as the "friend scramble…where everyone is so alone that they're just trying to latch on to whoever is next to them" (Wolburg, 2016: 84). This can leave students vulnerable to alcohol use as a means to fit in. Second, first-year students have greater autonomy than they are accustomed to, thereby allowing a continuation of identity exploration begun during adolescence (Zarrett & Eccles, 2006). This newfound freedom is vital for development, but allows greater capacity to explore risky behavior. Given this joint development of networks and behavior exploration, it is unsurprising that alcohol research routinely looks to peers as a key etiological factor (Baer, 2002; Borsari et al., 2007; Duncan et al., 2005; Rinker et al., 2016), especially close friends (Walther et al., 2017).

Oftentimes, alcohol is used to cope with the anxiety of the college transition and facilitate new friendships (Arnett, 2005; Wolburg, 2016). Consistent with this argument, alcohol use is

related to students naming more friends (Barnett, Ott, & Clark, 2014a) and being named more often as a friend (DiGuiseppi et al., 2018; Lorant & Nicaise, 2014; Phua. 2011). Moreover, students are likely to have friends who share their alcohol use behaviors (Abar & Maggs, 2010; Leibsohn, 1994; Leung et al., 2014; Read et al., 2005; Reifman et al., 2006; Stappenbeck et al., 2010; Leonard & Mudar, 2003). This can arise because university life exposes students to a range of peer alcohol use behaviors, allowing alcohol-based friendship preferences to operate. Students with positive alcohol expectations can readily find similar friends (e.g., within fraternities and sororities; McCabe et al., 2005; Park et al., 2009), whereas the pressure and scrutiny that accompany alcohol abstinence, leads non-drinking students to choose peers carefully (Conroy & de Visser, 2014). This points to our first research question: *to what extent do university students choose friends based upon alcohol use*?

The peers that students surround themselves with shape their decisions regarding risky behavior. Peer drinking behavior and alcohol norms are consistently associated with an individual's risk of drinking (DeMartini et al., 2013; Leonard & Mudar, 2000; Leung et al., 2014; Perkins 2002; Rinker et al., 2016; Wood et al., 2001). Explanations for alcohol misuse include modeling others' behavior (Ennett et al., 2008), perceived norms (Neighbors et al., 2007; Stappenbeck et al., 2010), and the quest for status among one's peers (Dumas et al., 2014). Peer influence among college students comes from a variety of sources, including high school friends (Crawford & Novak, 2018), new friends in college (Meisel & Barnett, 2017), randomly-assigned roommates (Duncan et al., 2005; Smith et al., 2019), and groups like fraternities and sororities (Capone et al., 2007; Phua, 2011). Such findings lead to our second research question: *how strongly does peer influence affect alcohol use among university students*?

Studies attempting to determine which of these overarching explanations—selection or influence—account for similarities in alcohol use among friends fail to offer a definitive answer (Ennett & Bauman, 1994; Leung et al., 2014; Gleuck & Gleuck, 1951; Kandel, 1978). Given evidence both processes regularly occur, it is wise to ask instead: what conditions underlie variation in the strength of selection and influence processes? We advance research in this direction by exploring changes across the first year of college. Rates of alcohol use and binge drinking fluctuate during the first year (Del Boca et al., 2004), as do peer-alcohol dynamics. For instance, first-year students are more strongly influenced by perceived norms than are upperclassmen (Turrisi et al., 2000), with perceptions of norms themselves changing over the college years (becoming more permissive for men than women; O'Grady et al., 2015). Moreover, students undergo shifts in the physical and social contexts where they consume alcohol, from house parties with expansive sets of peers early in college, to a more selective set of friends and exclusive contexts closer to graduation (Wolburg, 2016). These findings suggest that time within a context may affect selection and influence dynamics (Schaefer & Kreager, in press). Thus, our third question asks: *does the strength of peer influence and selection based on alcohol use change across a school year*?

First-year students are often focused on developing new friendships to help overcome the loneliness and uncertainty of their new environment (Hays & Oxley, 1986). However, new friendships are associated with risky alcohol use (Crawford & Novak, 2018), especially if new friends drink heavily (Meisel & Barnett, 2017). This may be because students drink to ease socializing and fit in (Wolburg, 2016); alcohol is readily-available in many of the settings where first-year students socialize (e.g., parties); or, new peers offer freedom to enact new behaviors (Crawford & Novak, 2018). Moreover, the importance of common alcohol use may change

during the year, with drinking together sufficient to foster early friendships (Wolburg, 2016), but deeper, shared interests determining which relationships persist over time (Newcomb, 1961). In light of this, we differentiate the role of alcohol use for friendship formation vs. friendship persistence and ask: *does the role of alcohol differ for new friendships versus determining which friendships persist over time*?

To answer these questions, we adopt a social network perspective wherein we track friendships between students over time. This approach offers several advantages compared to individual-centered designs (Knox et al., 2019). We incorporate self-report data on alcohol use from both students and their peers, thus overcoming concerns about self-attribution bias that accompany proxy reports of friends' use (DiGuiseppi et al., 2018; Rinker et al., 2016). Moreover, by measuring similarity in alcohol use specific to each friendship dyad, we readily distinguish the role of alcohol for friendship formation separate from the role of alcohol for friendship maintenance (Cheadle et al., 2013; Meisel & Barnett, 2017).

Our analysis uses a stochastic actor-oriented model (SAOM), which is a longitudinal network model designed to evaluate network and behavior change within bounded networks (Snijders et al., 2010; Steglich et al., 2010; Veenstra et al., 2013). With this model, peer influence and the effects of alcohol on friend selection are estimated net of one another and after controlling for correlates of alcohol use (e.g. the tendency to befriend peers of the same sex).

To date, research on friendships and alcohol has only used SAOMs to study secondary school students, finding both peer influence and homophilous selection (see review in Huang et al. 2014; Light et al., 2019; Long et al. 2017; Osgood et al., 2013). This is despite calls for longitudinal network studies (Barnett et al., 2014b; Rinker et al., 2016) and suggestions to investigate alcohol-network dynamics among university students with SAOMs (Reid & Carey,

2018). One likely reason is because SAOMs require information on relationships between all population members, making organization-wide studies of large universities difficult. One creative way to meet this condition has been to examine smaller, natural communities within the university, such as within majors or residence halls (Barnett et al., 2014b; Lorant & Nicaise, 2014) or, at one elite university, a freshman cohort (Barnett et al., 2019). Building on this approach, we examine a network of primarily first-year students living in the same residence hall.

METHOD

Study Design

During the 2015-2016 academic year, 1435 college students (92% first-year, 65% female) enrolled in the Social impact of Physical Activity and nutRition in College (SPARC) study (full details available in BLINDED). SPARC focused on associations between first-year college students' social networks and their nutrition, exercise, and weight change. Students came from a large, public, southwestern university where most first-year students live on campus.

Our analytical approach is a "complete" network design, which requires that we "enumerate first a population of interest and second all of the relationships between members of that population" (adams, 2020: 31). We defined our population as students living in the same residence hall, which is a major locus of social activity during students' first years. We initially targeted multiple residence halls for data collection, but did not obtain the needed saturation (too low for the SAOM analysis). To achieve suitable network data, we extended data collection by targeting another residence hall (the lone residence hall) on a separate campus, where we achieved a 70% response rate. This latter residence hall provides the sample of 300 students used in the current analysis.

Comparing our sample to the broader study revealed no difference by race/ethnicity (48% vs 47% non-Hispanic White; $p=0.718$) or first-year status (94% vs 98% first-year; $p=0.119$) but more females in our sample than in the broader study (71% vs 56% female; $p=0.002$). See Table 1 for sample demographics. Non-first-year students were resident assistants, retained in order to obtain a complete picture of the residence hall network. Students were targeted for four surveys (beginning and end of each semester). All students included in this study completed at least two assessments; 72% completed three assessments; and 52% completed all four assessments. All participants provided written consent and study protocols were approved by the [BLINDED] Institutional Review Board.

<div align="center">TABLE 1 HERE</div>

Measures

Friendships. At each wave, participants were asked to "rank your top 5 <u>male</u> and top 5 <u>female</u> friends <u>at [the university]</u> (the first being your best friend, the second being your next closest friend, and so on", as in the National Longitudinal Study of Adolescent Health (Harris, 2009; see also Jeon & Goodson, 2015). On average, students named 6.5 friends, of whom 3.1 resided within their residence hall. Our network is constructed using the sample of students and named friend residing in the focal residence hall.

Alcohol Consumption. Participants responding affirmatively to "Have you ever drank alcohol?" were asked "For each day of the week in the calendar, fill in the number of alcoholic drinks typically consumed on that day" with a response options for each day (Kruse et al., 2005). Respondents indicating at least one alcoholic drink were classified as weekly drinkers (coded 1), otherwise they were classified as non-drinkers (coded 0).

To examine binge drinking, participants reporting alcohol use were asked "During the last two weeks, how many times have you had <u>four</u> alcoholic drinks in a row?" (females; "five" for males) (Weschler et al., 1994). Participants indicating at least once were classified as binge drinkers (coded 1), with all others classified as non-binge drinkers (coded 0).

Sociodemographics. Participants self-reported their gender (0=male, 1=female), race/ethnicity (White, Black/African American, Hispanic/Latino/a, Asian/Pacific Islander, American Indian/Alaska Native, and other), and year in college (1=first-year, 0=other).

Statistical Model

The SOAM (Snijders et al., 2010; Steglich et al., 2010) parses the causal direction responsible for alcohol-network associations by simultaneously modeling friend selection and behavior change, allowing both "outcomes" to change endogenously. This is accomplished via two sub-models, represented by separate functions predicting alcohol use and friend selection. As shorthand, we refer to both weekly drinking and binge drinking as "alcohol use," but analyze them separately.

Friend Selection Function. Effects in the selection function represent mechanisms behind friendship change. This function predicts which friendships were more likely to form or persist across time. Three terms specify the effects of alcohol on friendship change: *ego* (whether participants who used alcohol were more likely to name friends than participants who did not use alcohol); *alter* (whether students who used alcohol were more likely to be named as a friend than non-drinkers); and *similarity (*whether students were more likely to name someone as a friend if they had the same level of alcohol use).

The selection function controlled for whether friendships were more likely among participants with the same residential floor, race/ethnicity, gender, and first-year status. We also

included ego and alter effects for these covariates. Following the recommended forward-fitting model strategy, we omitted these latter two effects from our final model if neither was statistically significant (Snijders et al., 2010). Lastly, the selection function contained several effects (e.g., reciprocity, transitive triplets, transitive reciprocated triplets, indegree popularity, indegree activity, outdegree activity) to represent common network processes that support friendships and can induce bias if omitted (definitions in Ripley et al., 2019).

Alcohol Use Function. The alcohol use function predicts which level of alcohol use students adopt (i.e., 0 or 1). Peer influence is captured with the *average alter* effect, which predicts one's alcohol use with the average among one's named friends (i.e., the proportion of friends who drink). As a robustness check, we tested for peer influence using the *total alter*, *total similarity*, and *average similarity* effects and obtained substantively similar results. We also checked whether older students (i.e., non-first-year) were more influential than first-year students, with no evidence this was the case. Controls included effects representing how gender, race/ethnicity, and year in college affected alcohol use. In addition, we controlled for whether students who named more friends (*outdegree*) or were named more often as a friend (*indegree*) were more or less likely to use alcohol.

To address our third and fourth research questions, we used a time-heterogeneity test (Ripley at al., 2019) to evaluate the assumption that parameter estimates representing controls were equal across the three periods of change (i.e., interspersed between four observation waves). Based on this test, we added dummy variables to represent change in the outdegree parameter (which reflect change in the overall tendency to name friends). Second, we estimated models that differentiated the role of alcohol for friendship creation versus friendship persistence. Third, we used the time-heterogeneity test to evaluate stability in parameter

estimates corresponding to alcohol-network associations (e.g., homophilous selection, peer influence). When significant, we added time offset terms that allowed the respective effect to vary in strength over time. In the interest of space, we only report significant time-heterogeneity tests. Analyses were conducted using R (version 3.6.2) and the 'RSiena' software package (version 1.2-23). Post-hoc tests were used to ensure adequate goodness of fit (see Supplemental Figure S1). For students missing in waves 2-4, we followed the recommended approach of using the model to impute alcohol use scores and network ties (Huisman & Steglich, 2008).

RESULTS

Descriptive Analyses

On average, 45% of students reported drinking alcohol weekly, and 28% reported binge drinking in the past 2 weeks (Table 2). Respondents were similar to their friends in weekly alcohol use, with friendships 1.6 to 1.8 times more likely among students with the same alcohol use status. This is evident in Figure 1, which shows clusters of drinkers and non-drinkers toward the left and right sides, respectively, of each network. By contrast, similarity on binge drinking was weaker and only significant in the first semester (i.e., fall). The Jaccard indices indicate that from 52-65% of friendships observed in adjacent waves were present at both times.

TABLE 2 HERE

FIGURE 1 HERE

Friend Influence

Table 3 presents key estimates for the weekly drinking and binge drinking models (Supplemental Tables S1-S2 report full results). We find no effects of friendship volume on alcohol use or binge drinking. Neither naming more friends (*outdegree*) nor being named more often as a friend (*indegree*) led to changes in one's own alcohol use. The only significant

predictor of drinking was average friends' drinking. The *average alter* estimates for weekly

drinking (*b*=1.95 *p*=.026) and binge drinking (*b*=1.91, *p*=.021) offer evidence of peer influence.

<center>TABLE 3 HERE</center>

To convey the magnitude of peer influence, we exponentiated the raw parameter to obtain

the expected multiplicative change in odds of drinking vs. not drinking if all vs. none of one's

friends drink (i.e., a one-unit change in the proportion of friends who drink). This calculation

reveals that students were 7.0 times more likely to drink alcohol weekly (exp[1.95]) when all

their friends drank weekly vs. when none of their friends drank weekly. Similarly, students were

6.8 times more likely to binge drink (exp[1.91]) when all, vs. none, of their friends reported

binge drinking.

Friend Selection

The lower half of Table 3 presents estimates for friend selection that constrain effects to

be equal for friendship formation and persistence. In presenting results, we refer to the weekly

drinking model unless otherwise indicated. Controls indicate that when given the opportunity to

change their network, students were more likely to be friends if they resided on the same floor

(*b*=.22, *p*=.048) or shared a common race/ethnic identification (*b*=.28, *p*<.001). We also observe

a tendency for friendships among participants with the same first-year status (*b*=1.30, *p*<.001).

However, the negative alter effect (*b*=-1.23, *p*<.001) indicates that non-first-year students were

less likely to be selected overall, meaning they also had a weaker tendency to befriend one

another than first-year students. The significant gender alter effect (*b*=.51, *p*<.001) indicates

males were more likely to be nominated as a friend than females. Significant network controls

indicate that first-year friendship change followed the same processes commonly found in other

friendship networks. For instance, friends tended to name one another (*reciprocity*) and have

friends in common (*transitive triplets*; Snijders et al., 2010; Ripley et al., 2019).

Results for the effects of alcohol on friendship suggest that students who drank weekly

were less likely to be selected as a friend than students who did not drink weekly (b=-.29, p=.03).

Turning to Model 2, binge drinking had no effect on friend selection. Estimates revealed no

tendency for friendships among students with similar binge drinking behavior (b=.09, p=.669).

And students engaged in binge drinking were no more likely to be named a friend (b=-.06,

p=.739) or name friends (b=-.06, p=.752) than students who did not binge drink.

Results for models differentiating alcohol-based friendship creation from persistence

offer interesting new insights (Table 4). Beginning with friendship creation, students were more

likely to befriend peers with similar weekly drinking (b=.46, p=.046) and weekly drinkers named

more new friends than non-drinkers (b=4.41, p<.001). In combination, this suggests weekly

drinkers were more likely than non-drinkers to form new friendships, especially with peers who

were also weekly drinkers. Our time heterogeneity test indicated students who drank weekly

were significantly more likely to be named as a new friend in period 2 (wave 2 to 3; b=.997,

p=.026). By contrast, students who drank weekly were less likely to keep friends (b=-4.10,

p<.001) or be kept as a friend (b=-.86, p=.002) than students who did not drink weekly. Net of

these effects, alcohol use similarity did not affect friendship persistence (b=-.15, p=.633).

TABLE 4 HERE

We followed the same model estimation procedure for binge drinking. These results

indicate that students engaged in binge drinking were more likely to name new friends each

wave (b=6.18, p=.020) but less likely to keep those friends (b=-6.43, p=.013). As with weekly

drinking, binge drinkers were more likely to be named as a new friend only during period 2

(b=1.04, p=.029). Similarity on binge drinking did not affect friendship formation (b=.45, p=.196) or maintenance (b=-.31, p=.461).

DISCUSSION

As in high school, college students tend to have friends who share their alcohol use behavior (Abar & Maggs, 2010; Barnett et al., 2014b). Our goal was to test whether this pattern is due to interpersonal influence, or whether, as part of first-year students' network development process, students found new friends who share their pre-existing alcohol behaviors. We gathered longitudinal data on friendship and alcohol use from first-year university students within the same residential dormitory, which enabled a network analysis to discern selection from influence processes and overcome concerns about self-attribution bias (Barnett et al., 2014b; DiGuiseppi et al., 2018; Rinker et al., 2016).

Our results offer strong evidence of peer influence on weekly alcohol use and binge drinking. Students were more likely to engage in both behaviors as the proportion of their friends engaged in the behavior increased. We found no evidence these effects changed in strength over the school year. Our peer influence finding is consistent with other studies of college students (Knox et al., 2019; Rinker et al., 2016), but noteworthy because unlike prior studies we explicitly control for the role of alcohol in determining which specific friends are chosen. Unfortunately, we were not sufficiently powered to discern differences in peer influence strength for increases vs. decreases in alcohol use (e.g., Haas & Schaefer, 2014), due to insufficient observations of each type of change. For practical purposes, it is important to determine the relative risk vs. protective function of friends (Reid et al., 2015) and whether such effects shift across the college years.

While prior studies have examined the consequences of friendship turnover for alcohol use (Crawford & Novak, 2018; Reifman et al., 2006), ours is the first to consider how alcohol use works differently for forming friendships versus keeping friends in college. Our initial models revealed that weekly drinkers were less likely to be chosen as friends. However, when differentiating friendship formation from persistence, a more complex pattern emerged. In creating new friendships, both drinkers and non-drinkers were more likely to befriend peers with the same weekly drinking status. Finding that similarity in alcohol use only mattered for friendship creation parallels a comparable study of high school students (Cheadle et al., 2013) and studies finding homophily across the college transition (Abar & Maggs, 2010; Barnett et al., 2014b). We also found that weekly alcohol use (but not binge drinking) led students to name more new friends in each wave, while both weekly and binge drinkers were more likely to be named as a new friend in period 2. These results align with previous findings that network centrality is positively associated with alcohol use (Barnett et al., 2014a; DiGuiseppi et al., 2018; Lorant & Nicaise, 2014; Phua. 2011). All told, these findings suggest homophily may be most critical at the meeting stage (Fine, 1980; van Duijn et al., 2003). Drinkers were initially seen as more attractive potential friends – especially by fellow drinkers – perhaps because they offered a route to excitement, carried higher social status (Dumas et al., 2014), or because drinking was seen as part of the college experience and a way to establish a new community (Wolburg, 2016). Likewise, non-drinkers were more likely to befriend fellow non-drinkers. Thus, our findings indicate a prominent role of similar alcohol use in friendship formation.

However, in determining which friendships endured, we found alcohol use itself, not similarity, was associated with greater friendship dissolution. This might be attributable to problems associated with drinking (Rose, 1984) or because alcohol use affected friendship

quality, though evidence here is mixed (Lau-Barraco & Linden, 2014; Stogner, Boman, & Miller, 2015), highlighting the need to dive deeper into the nature of this association and the mechanisms behind it. Theoretically and methodologically, these findings point to the importance of separately considering the phases of friendship during times of dramatic network change (van Duijn et al., 2003).

Another worthwhile step is to evaluate longer spans of time as selection and influence processes may shift in strength across the college years (O'Grady et al., 2011; Wolburg, 2016). For instance, Ragan (2019) found that peer influence on substance use was stronger in early middle school grades, with selection gaining relative strength in later grades. He attributed this pattern to the importance of friends for substance use initiation, which parallels findings on peer influence and alcohol use onset (Light et al., 2013). In the university context, it may be that peer norms are particularly salient early in the college career as students adjust to their new context, before fading over time. Friend selection rules may also change over time (Schaefer & Kreager, in press). Once the urgency of first-year friendship development passes (Wolburg, 2016), more deeply held values and interests can drive friendship (Newcomb, 1961).

A notable limitation is our sample came from one campus and residence hall, which many not be representative more broadly. The residence hall offered a suitable boundary for our SAOM analysis, though admittedly a porous one as students had friends outside their dorm. We believe this is a worthwhile tradeoff in order to take advantage of the SAOM's capacity to evaluate influence and selection. However, the downside is that our generalizations are limited to alcohol-network dynamics among students living in the same residence hall. Co-residing students likely spend more time together than students living further apart, which might affect the strength of peer influence. Moreover, friendships outside the dorm often develop within

contexts with distinct alcohol use norms (e.g., Greek houses, parties, religious groups) that could alter the direct effects of alcohol on friendship. In light of this, we call for targeting a broader sample, such as an entire freshman class (e.g., Barnett et al., 2019), to ascertain such differences.

College is a risky period for alcohol misuse, thus understanding the roots of alcohol use is vital to devising strategies to effectively dampen this risk. Our findings point to the complex role of alcohol in the process of re-creating students' friendship networks and underscore friend selection as a vital step to determining which peers will serve as a frame of reference in the future (Schaefer, 2018). Our findings reinforce the importance of intervention efforts that recognize the role of peer influence (Perkins, 2002; Perkins et al., 2005) but also point to a potentially useful way to counter beliefs that alcohol use is a good way to find friends (Wolburg, 2016). It may be worthwhile to emphasize to students that the friendships developed around alcohol are oftentimes transitory. While alcohol may alleviate loneliness in the short term, it may not help develop the kind of longstanding friendships that support students throughout college. Such a message could be included alongside statistics on normative drinking behavior in social norm campaign media. With this in mind, replication of this finding is needed, as well as work to understand the mechanisms responsible. Intervention efforts may benefit from understanding the strategies first-year students use to navigate friendships and the friend selection principles they enact as a means to avoid relationships that promote risky behavior.

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Table 1: Sample Demographics (n=300)

Gender, n (%)	
Female	214 (71.3)
Male	86 (28.7)
Race/ethnicity, n (%)	
Non-Hispanic White	144 (48.0)
Non-Hispanic Black	29 (9.7)
Hispanic	87 (29.0)
Other	40 (13.3)
Year in college, n (%)	
First-year student	281 (93.7)
Other	19 (6.3)

Table 2: Network Characteristics over Time

	Wave 1	Wave 2	Wave 3	Wave 4
Alcohol Use				
Typical drinking, mean (sd)	0.48 (0.50)	0.46 (0.50)	0.45 (0.50)	0.42 (0.50)
Binge drinking, mean (sd)	0.31 (0.46)	0.27 (0.44)	0.29 (0.45)	0.25 (0.44)
Network				
Outgoing ties (outdegree), mean (sd)	3.3 (1.9)	3.1 (1.8)	2.9 (1.9)	2.8 (1.8)
Incoming ties (indegree), mean (sd) [a]	2.4 (2.4)	2.2 (2.2)	2.0 (2.2)	1.6 (1.8)
Density [b]	.011	.010	.010	.009
Jaccard (from previous wave) [c]		0.52	0.65	0.56
Alcohol & Network				
Similarity on typical drinking [d]	1.81***	1.66***	1.56***	1.77***
Similarity on binge drinking [d]	1.29*	1.29*	1.05	1.02
Correlation of weekly drinking with outdegree	0.16*	0.13	0.12	0.18*
Correlation of weekly drinking with indegree	0.19**	0.12	0.03	0.09
Correlation of binge drinking with outdegree	0.13	0.17*	0.08	0.21**
Correlation of binge drinking with indegree	0.17**	0.24***	0.02	0.14*

[a] Average outdegree does not equal average indegree because some students who did not participate during a wave were named as a friend, but could not have named friends.

[b] Density is calculated as the number of ties present in a network divided by the number possible. Potential ties emanating from non-respondents are excluded from this calculation.

[c] Jaccard coefficients represent number of ties that are stable from the preceding to the current wave, divided by the number of dyads that displayed a tie in either wave.

[d] Similarity is an odds ratio, defined as the odds of a friend having the same alcohol use level vs. a different level, relative to the odds of a non-friend having the same vs. a different level.

* $p < .05$; ** $p < .01$; *** $p < .001$

Table 3: Select Estimates from SAOMs of Friend Selection and Weekly Alcohol Use or Binge Drinking

	Weekly Drinking		Binge Drinking	
	b	SE	b	SE
Alcohol Use Function				
Effects of Friendship Network				
Indegree	0.03	(0.13)	0.07	(0.11)
Outdegree	0.06	(0.20)	0.06	(0.17)
Average alter weekly drinking	1.95 *	(0.87)	---	
Average alter binge drinking	---		1.91 *	(0.82)
Covariate Controls				
White	0.09	(0.54)	-0.01	(0.46)
Hispanic	-0.21	(0.60)	0.01	(0.50)
Black	-1.02	(0.85)	-1.09	(0.77)
Male	-0.06	(0.44)	-0.06	(0.36)
First-year	-0.66	(0.67)	0.13	(0.56)
Friend Selection Function				
Alcohol Use				
Weekly drinking similarity	0.21	(0.14)	---	
Weekly drinking alter	-0.29 *	(0.13)	---	
Weekly drinking ego	0.24	(0.16)	---	
Binge drinking similarity	---		0.09	(0.21)
Binge drinking alter	---		-0.06	(0.18)
Binge drinking ego	---		-0.06	(0.19)
Covariate Controls				
Floor same	0.22 *	(0.11)	0.23 *	(0.11)
Race/ethnicity same	0.28 ***	(0.08)	0.27 ***	(0.08)
Male same	0.15	(0.09)	0.15	(0.09)
Male alter	0.51 ***	(0.10)	0.49 ***	(0.10)
Male ego	-0.08	(0.13)	-0.05	(0.13)
First-year same	1.30 ***	(0.20)	1.32 ***	(0.20)
First-year alter	-1.23 ***	(0.23)	-1.20 ***	(0.23)
First-year ego	0.24	(0.24)	0.20	(0.23)
Network Controls				
Reciprocity	4.72 ***	(0.36)	4.75 ***	(0.35)
Transitive triplets	0.96 ***	(0.10)	0.97 ***	(0.09)
Transitive triplets X reciprocity	-0.76 ***	(0.12)	-0.76 ***	(0.11)
Indegree - popularity ($\sqrt{}$)	0.39 ***	(0.09)	0.39 ***	(0.09)
Indegree - activity ($\sqrt{}$)	-0.97 ***	(0.24)	-1.00 ***	(0.25)
Outdegree - activity ($\sqrt{}$)	-0.52 ***	(0.19)	-0.48 ***	(0.18)

* $p < .05$; ** $p < .01$; *** $p < .001$.

Table 4: Select Estimates from SAOMs of Friend Selection and Weekly Alcohol Use or Binge Drinking that Distinguish Friendship Creation from Friendship Maintenance
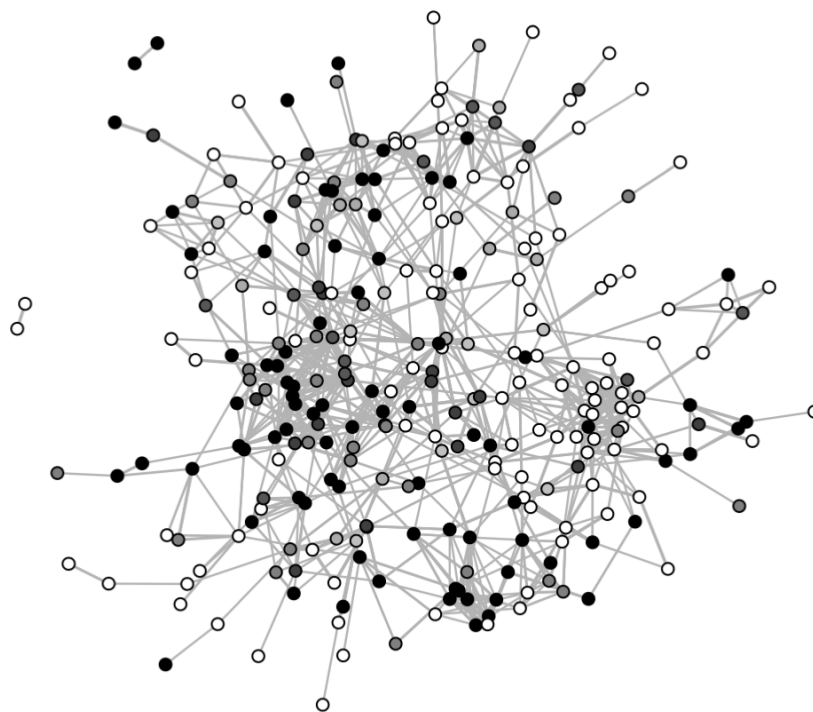
	Weekly Drinking		Binge Drinking	
	b	SE	b	SE
Friendship Creation Function				
Weekly drinking similarity	0.46 *	(0.23)	---	
Weekly drinking alter	0.18	(0.20)	---	
x Period 2	1.00 *	(0.45)	---	
x Period 3	-0.48	(0.40)	---	
Weekly drinking ego	4.41 ***	(0.98)	---	
Binge drinking similarity	---		0.45	(0.34)
Binge drinking alter	---		-0.05	(0.29)
x Period 2	---		1.04 *	(0.47)
x Period 3	---		-0.87	(0.70)
Binge drinking ego	---		6.17 *	(2.63)
Friendship Persistence Function				
Weekly drinking similarity	-0.15	(0.31)	---	
Weekly drinking alter	-0.86 ***	(0.27)	---	
Weekly drinking ego	-4.10 ***	(0.99)	---	
Binge drinking similarity	---		-0.31	(0.42)
Binge drinking alter	---		-0.13	(0.31)
Binge drinking ego	---		-6.43 *	(2.56)

* $p < .05$; ** $p < .01$; *** $p < .001$.

FIGURE CAPTIONS

Figure 1. Friendship network with nodes shaded by student average alcohol use across waves. Nodes shaded white denote non-drinking students at each observation; nodes shaded black denote weekly drinkers at each observation (top panel) or binge drinkers at each observation (bottom panel). Shades of gray denote students whose drinking shifted across waves (with lighter colors denoting fewer waves of reported drinking). For display purposes only, nodes were connected by a tie if either student reported a friendship at any wave. Thirteen isolates not displayed.

Weekly Drinking

Binge Drinking
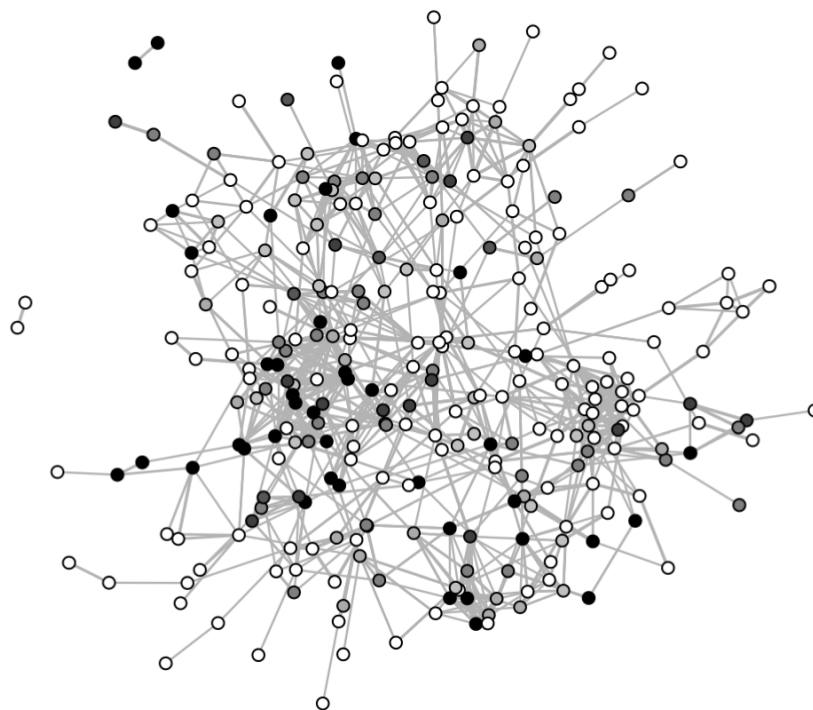
Table S1. Full Output from SAOMs of Friend Selection and Weekly Alcohol Use or Binge Drinking (summarized in Table 3)

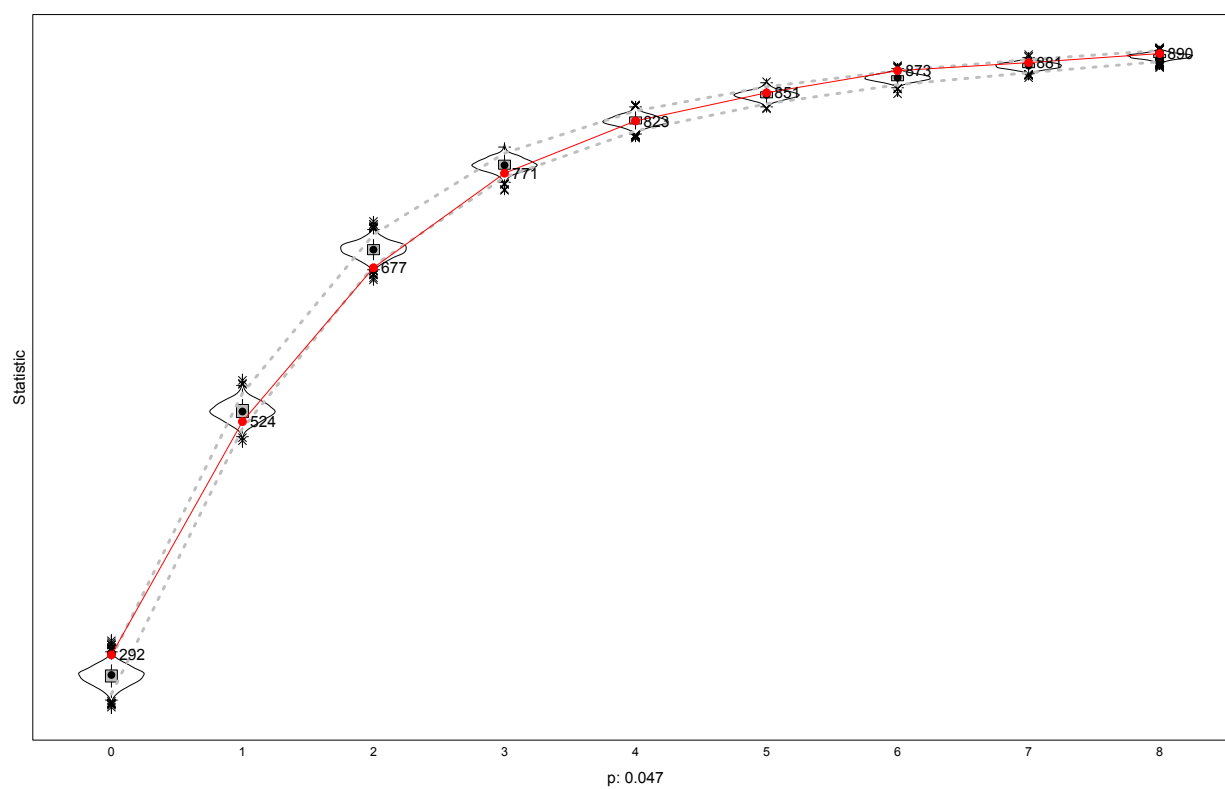|	Weekly Drinking		Binge Drinking	
	b	SE	b	SE
Friend Selection Function				
constant friendship rate (period 1)	4.344 ***	0.345	4.347 ***	0.361
constant friendship rate (period 2)	2.246 ***	0.197	2.252 ***	0.197
constant friendship rate (period 3)	3.308 ***	0.306	3.294 ***	0.309
outdegree (density)	-3.716 ***	0.456	-3.767 ***	0.458
reciprocity	4.725 ***	0.358	4.742 ***	0.383
transitive triplets	0.963 ***	0.095	0.970 ***	0.094
transitive recipr. triplets	-0.759 ***	0.117	-0.758 ***	0.113
indegree - popularity (sqrt)	0.399 ***	0.094	0.382 ***	0.099
indegree - activity (sqrt)	-0.968 ***	0.241	-0.995 ***	0.254
outdegree - activity (sqrt)	-0.525 ***	0.190	-0.480 ***	0.177
same Floor	0.220 *	0.108	0.225 *	0.109
Gender alter	0.510 ***	0.103	0.487 ***	0.100
Gender ego	-0.075	0.131	-0.047	0.127
same Gender	0.153	0.089	0.151	0.089
same White	0.277 ***	0.079	0.274 ***	0.078
first-year alter	-1.231 ***	0.230	-1.196 ***	0.229
first-year ego	0.237	0.241	0.199	0.235
first-year status	1.299 ***	0.200	1.319 ***	0.198
alc alter	-0.294 *	0.130	-0.056	0.176
alc ego	0.244	0.159	-0.059	0.190
alc similarity	0.210	0.139	0.088	0.209
Dummy2:friendship ego	-0.309 **	0.132	-0.304 *	0.132
Dummy3:friendship ego	-0.260 *	0.127	-0.252 *	0.127
Alcohol Use Function				
rate alc (period 1)	0.456 ***	0.084	0.909 ***	0.166
rate alc (period 2)	0.508 ***	0.102	0.725 ***	0.166
rate alc (period 3)	0.499 ***	0.106	0.900 ***	0.187
alc linear shape	-0.680	0.392	-1.557 ***	0.342
alc indegree	0.033	0.131	0.071	0.107
alc outdegree	0.062	0.199	0.058	0.171
alc average alter	1.951 *	0.872	1.906 *	0.820
alc: effect from Gender	-0.063	0.437	-0.061	0.362
alc: effect from White	0.090	0.544	-0.014	0.457
alc: effect from Hisp	-0.207	0.604	0.003	0.500
alc: effect from Black	-1.022	0.847	-1.092	0.770
alc: effect from v	-0.655	0.671	0.131	0.562

* $p < .05$; ** $p < .01$; *** $p < .001$.

Table S2. Full Output from SAOMs of Friend Selection and Weekly Alcohol Use or Binge Drinking that Distinguish Friendship Creation from Friendship Maintenance (summarized in Table 4)
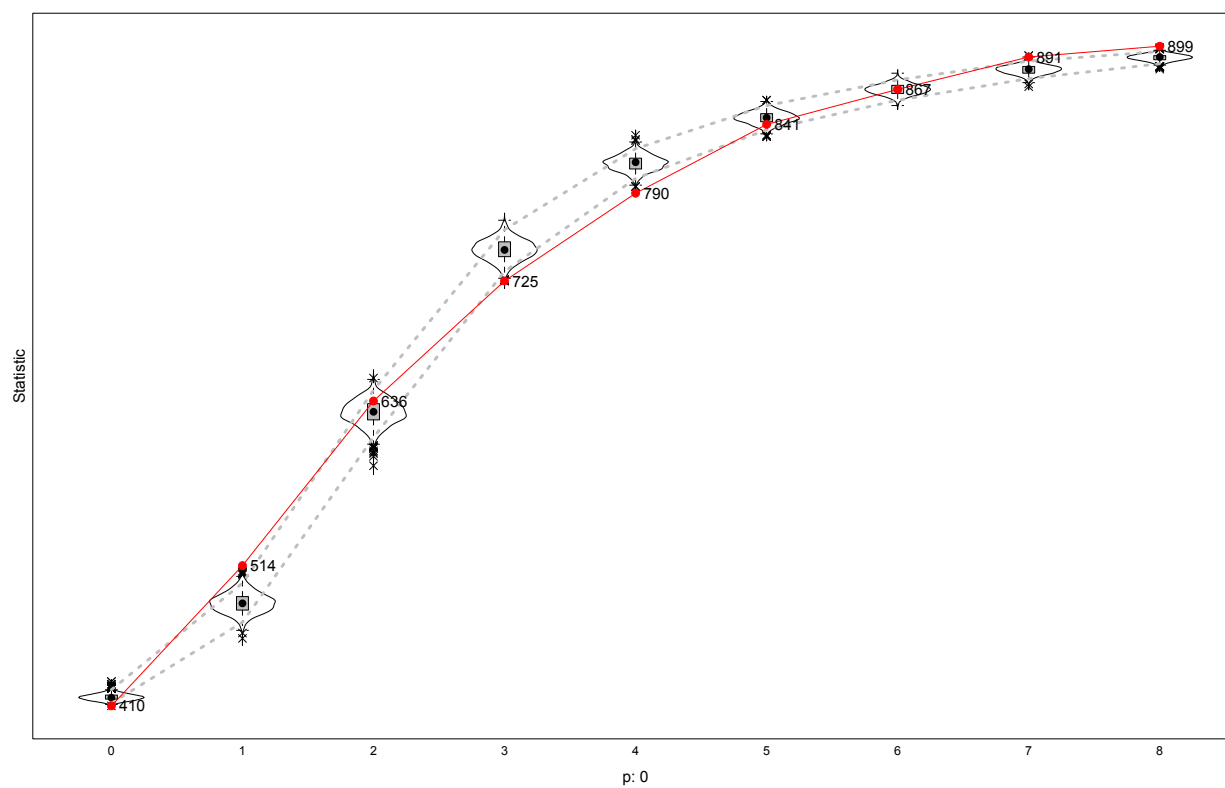
	Weekly Drinking			Binge Drinking		
	b		SE	b		SE
Friend Selection Function						
constant friendship rate (period 1)	4.853	***	0.489	5.011	***	0.776
constant friendship rate (period 2)	2.599	***	0.266	2.632	***	0.386
constant friendship rate (period 3)	3.803	***	0.441	3.867	***	0.604
outdegree (density)	-3.695	***	0.411	-3.750	***	0.408
reciprocity	4.563	***	0.348	4.467	***	0.347
transitive triplets	0.930	***	0.089	0.903	***	0.094
transitive recipr. triplets	-0.739	***	0.109	-0.708	***	0.112
indegree - popularity (sqrt)	0.345	***	0.090	0.339	***	0.086
indegree - activity (sqrt)	-0.948	***	0.231	-0.884	***	0.223
outdegree - activity (sqrt)	-0.458	***	0.163	-0.443	***	0.169
same Floor	0.249	**	0.105	0.249	**	0.103
Gender alter	0.487	***	0.098	0.466	***	0.099
Gender ego	-0.040		0.122	-0.051		0.120
same Gender	0.128		0.087	0.147	†	0.087
same White	0.272	***	0.078	0.268	***	0.077
first-year alter	-1.247	***	0.228	-1.151	***	0.229
first-year ego	0.245		0.237	0.179		0.232
same first-year	1.333	***	0.197	1.312	***	0.202
alc alter (endow)	-0.864	***	0.271	-0.125		0.307
alc alter (create)	0.185		0.199	-0.048		0.291
alc ego (endow)	-4.103	***	0.991	-6.434	**	2.565
alc ego (create)	4.409	***	0.983	6.175	**	2.632
alc similarity (endow)	-0.149		0.311	-0.307		0.416
alc similarity (create)	0.457	*	0.228	0.446		0.345
Dummy2:friendship ego	-0.346	***	0.130	-0.332	***	0.127
Dummy3:friendship ego	-0.275	*	0.119	-0.258	*	0.126
int. Dummy2:friendship ego x alc alter (create)	0.997	*	0.447	1.038	*	0.473
int. Dummy3:friendship ego x alc alter (create)	-0.478		0.403	-0.873		0.704
Alcohol Use Function						
rate alc (period 1)	0.461	***	0.086	0.913	***	0.177
rate alc (period 2)	0.513	***	0.103	0.709	***	0.153
rate alc (period 3)	0.502	***	0.107	0.906	***	0.205
alc linear shape	-0.716	†	0.410	-1.534	***	0.348
alc indegree	0.033		0.127	0.074		0.106
alc outdegree	0.072		0.199	0.051		0.169
alc average alter	1.964	*	0.846	1.928	**	0.819
alc: effect from Gender	-0.078		0.434	-0.059		0.363
alc: effect from White	0.086		0.546	-0.023		0.455
alc: effect from Hisp	-0.216		0.609	0.007		0.493
alc: effect from Black	-1.028		0.842	-1.089		0.765
alc: effect from first-year	-0.662		0.668	0.115		0.564

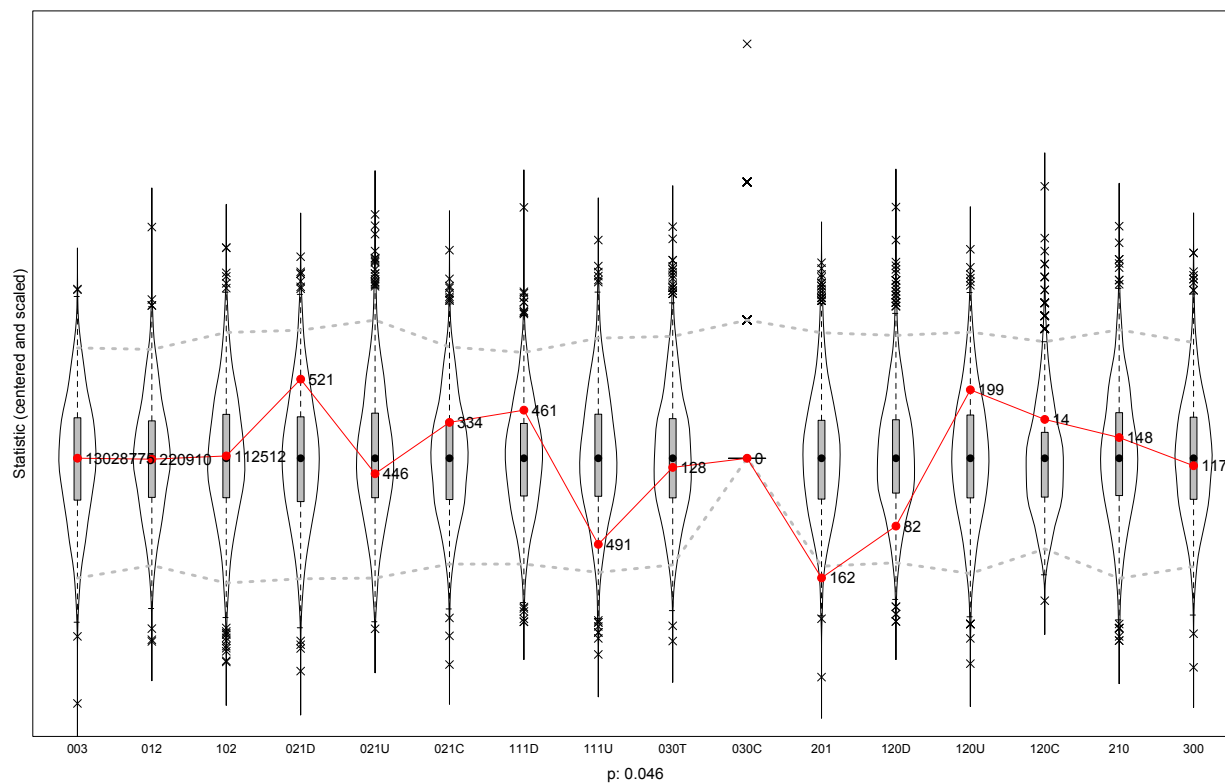$* p < .05; ** p < .01; *** p < .001.$

Figure S1. Goodness of Fit

Goodness of Fit of IndegreeDistribution
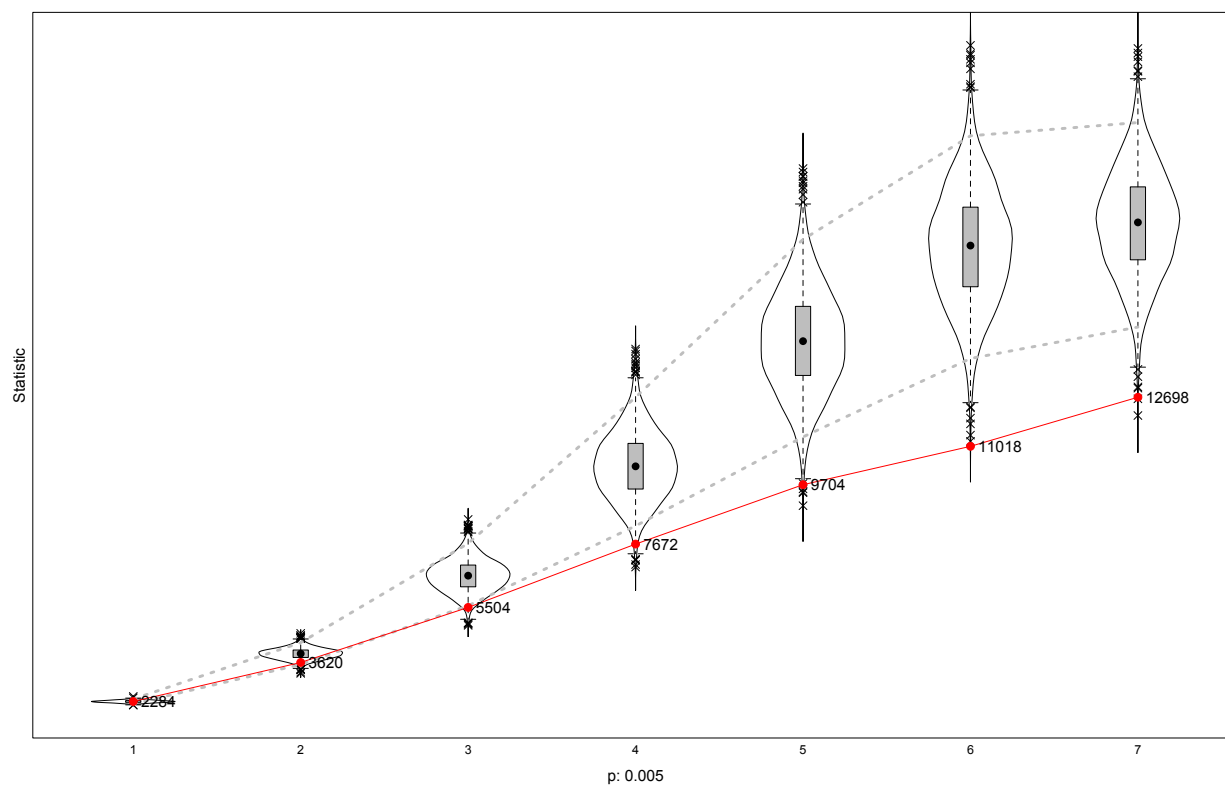

p: 0.047

Goodness of Fit of OutdegreeDistribution

p: 0
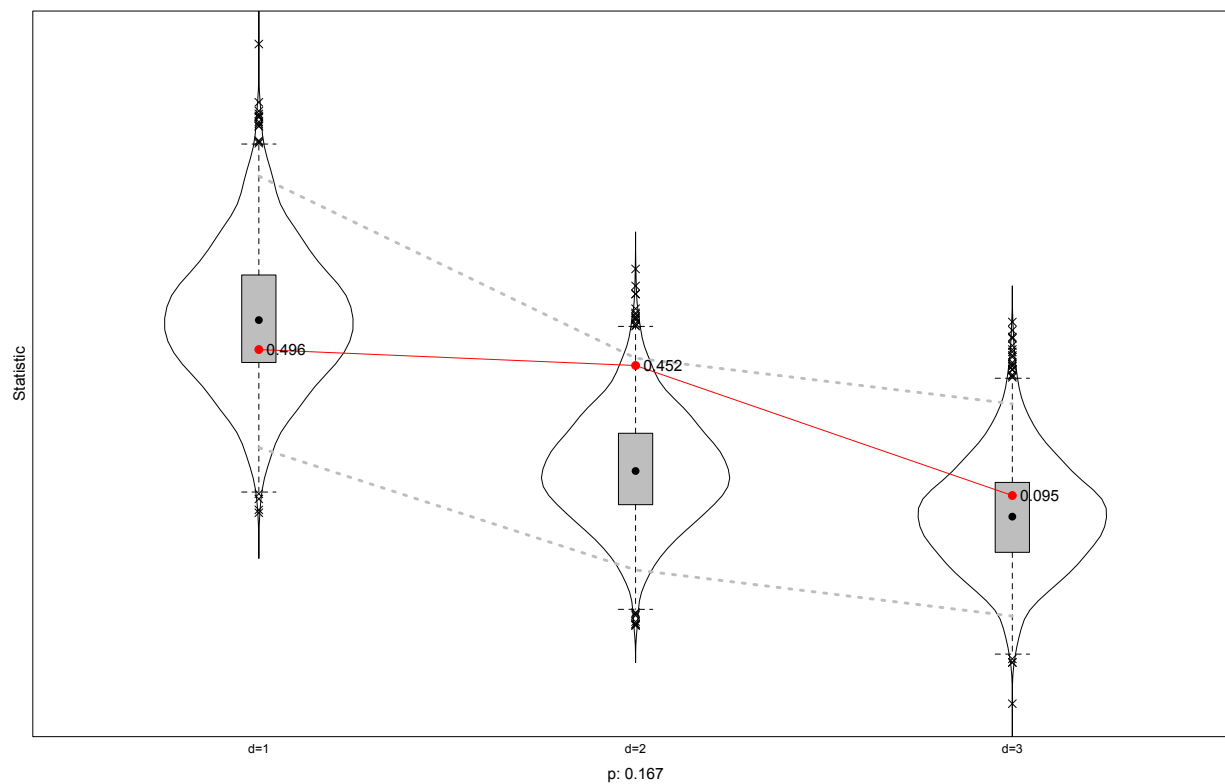
Goodness of Fit of TriadCensus

Goodness of Fit of GeodesicDistribution

Goodness of Fit for Weekly Drinking: Morans I at Distance 1-3

p: 0.167

Goodness of Fit for Binge Drinking: Morans I at Distance 1-3

p: 0.026