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Enrollment and Assessment of a First-Year College Class Social Network for a Controlled Trial of the Indirect Effect of a Brief Motivational Intervention

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Abstract

Heavy drinking and its consequences among college students represent a serious public health problem, and peer social networks are a robust predictor of drinking-related risk behaviors. In a recent trial, we administered a Brief Motivational Intervention (BMI) to a small number of first-year college students to assess the indirect effects of the intervention on peers not receiving the intervention.

Objectives: To present the research design, describe the methods used to successfully enroll a high proportion of a first-year college class network, and document participant characteristics.

Methods: Prior to study enrollment, we consulted with a student advisory group and campus stakeholders to aid in the development of study-related procedures. Enrollment and baseline procedures were completed in the first six weeks of the academic semester. Surveys assessed demographics, alcohol use, and social network ties. Individuals were assigned to a BMI or control group according to their dormitory location.

Results: The majority of incoming first-year students (1,342/1,660; 81%) were enrolled (55% female, 53% nonwhite, mean age 18.7 [*SD* = .51]). Differences between the intervention and

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control group were noted in alcohol use, but were in large part a function of there being more substance-free dormitory floors in the control group.

Conclusions: The current study was successful in enrolling a large proportion of a first-year college class and can serve as a template for social network investigations.

Keywords

study design; implementation; alcohol; college; social network; intervention

1. Introduction

Prevalence rates for heavy drinking and alcohol-related consequences are highest among 18-25 years olds relative to other age groups, and college students face escalated risk (Carter, Brandon, & Goldman, 2010; Patrick & Schulenberg, 2011; White & Hingson, 2013). The first year of college is a particularly risky developmental period because matriculating into college is associated with increased hazardous drinking that may adversely impact academic and social transitions (Borsari, Murphy, & Barnett, 2007; NIAAA, 2002; O'Neill, Parra, & Sher, 2001). Peers are among the strongest influences on students' drinking-related beliefs and behaviors. Having heavy drinking friends is concurrently and prospectively associated with pro-alcohol beliefs and heavier drinking among college students (Delucchi, Matzger, & Weisner, 2008; DeMartini, Prince, & Carey, 2013; Meisel & Barnett, 2017; Reifman, Watson, & McCourt, 2006), and peer affiliations in the first semester of college are particularly salient (Talbott, Moore, &Usdan, 2012).

Social learning theories posit that peers influence each other's alcohol-related behaviors through overt (social reinforcement and direct provision of alcohol) and indirect (modeling and perceived norms) processes (Bandura, 1977, 1986; Borsari & Carey, 2001;Maisto, 1999). Moreover, consistent with social learning theory, social network theorists assert that centrally situated individuals have a stronger influence on others' behavior than less central network members (Kadushin, 2005; Valente, 2010; Wasserman & Faust, 1994). Social network interventions have effectively drawn on centrally positioned, high-status network members to convey healthy messaging to modify collective norms related to, for instance, HIV risk behavior in community social networks (Heckathorn, Broadhead, Anthony, & Weakliem, 2012; Kelly et al., 1991;Latkin et al., 2009) and substance use in school social networks (Gottfredson & Wilson, 2003; Mellanby, Rees, & Tripp, 2000; Paluck & Shepherd, 2012). However, no studies to date have examined the potential for an alcohol intervention targeted at influential network members to transmit healthier drinking attitudes and behaviors within a college social network.

We conducted a clinical intervention trial in a first-year college student cohort. Intervention (Brief Motivational Intervention; BMI) and control group (Natural History Control; NHC) assignments were defined according to dormitory location on campus. The purpose of this trial was to examine potential diffusion effects of the BMI (reduced alcohol use and related problems) *to members in the BMI group who received no direct intervention*. First, a subset of heavy drinkers who had high proximity to other heavy drinkers within the BMI group network were assigned to receive a BMI, a validated NIAAA Tier 1 recommended

intervention for reducing alcohol use and consequences in college students (NIAAA, 2002). The other heavy drinkers (and all non-heavy drinkers) in the BMI group received no direct intervention. Controls for those who received the BMI intervention were selected using the same approach in the NHC group (i.e., those who had high proximity to other heavy drinkers in their group). Heavy drinkers in the BMI group who were not selected to receive the intervention also had controls in the NHC group. In other words, there were two subgroups of heavy drinkers in the BMI and NHC groups: heavy drinkers who were assigned to actually receive BMI (and their controls in NHC), and heavy drinkers who were not assigned to receive BMI (and their controls in NHC). An important innovation in our design (Ott, Light, Clark, & Barnett, in press) was the creation of a method for selecting BMI intervention recipients and their NHC controls that optimized linkages to other heavy drinkers in their own group and minimized linkages to heavy drinkers in the opposite group; details and rationale are explained further below.

We reasoned that support for the indirect effect of the BMI would be shown if heavy drinkers who were not selected to receive the intervention reduced their alcohol-related risk behaviors more than their counterparts in the NHC group. We hypothesized that heavy drinking participants in the BMI group would reduce alcohol use and consequences more than their counterparts in the NHC groups following the intervention. Because social network studies necessitate enrolling and retaining a high proportion of the network to understand network connections and behaviors, we present the design of the trial and methods used to successfully enroll and retain a majority of a first-year college class. We also describe the network as a whole and the demographics, alcohol use, and network characteristics of the two (BMI and NHC) groups.

2. Materials and Methods

Design

To investigate whether behavior change following a brief alcohol intervention would diffuse through a social network, we used a two-group (BMI vs. NHC) design. Students were enrolled midway through the first academic semester, and dormitories in two geographically separated areas on campus were assigned to BMI or NHC. Segmenting the two groups based on proximity was done to reduce contamination between the two groups following intervention. Immediately after the baseline assessment, which included the network survey, more frequent heavy drinkers (more than one heavy drinking day in the past month) in both (BMI and NHC) groups were identified, and 27% of these participants were selected (to result in 25% after attrition) based on their optimal position in their BMI/NHC group, which we defined as having a high proportion of network ties to other heavy drinkers in their group but not to heavy drinkers in the other group. Individuals that were selected based on their optimal position in the BMI group served as intervention recipients; NHC participants who were selected served as controls for the BMI intervention recipients. By selecting a set of individuals who were highly connected within their group but not to the other group, we sought to optimize the transmission of the intervention within the BMI group but to avoid transmission to the NHC group. We selected intervention recipients from the more frequent heavy drinkers to increase the likelihood that their behavior change (as a function of our

intervention) would influence other heavy drinkers. All BMI group heavy drinkers were considered (either direct or indirect) recipients of the BMI. Readers are referred to Ott et al. (in press) and an R implementation package (Ott, 2016) for a complete description of the method for selecting intervention recipients using social network data. All methods were approved by the University Institutional Review Board.

Participants

All first-year incoming students enrolled in the fall of 2016 at a mid-sized, private university in the northeast were eligible to enroll in the study with three exceptions: non-traditional students who participated in a small program for returning undergraduates ($n = 11$), students participating in a dual program with another college and therefore not living on the study campus in their first year ($n = 18$), and students who were not living on campus ($n = 3$). Participant characteristics are in Table 1. Participants were on average 18.6 years old ($SD = 0.51$), 55.3% female, 15.3% Hispanic/Latino, 47.7% Non-Hispanic white, 22.7% Non-Hispanic Asian, 6.3% Non-Hispanic black, 8.2% multiple races/ethnicities, and 1.1% other. The BMI group had 585 participants and the NHC group had 757; after data cleaning (see procedures below), group sizes were 576 in BMI and 749 in NHC.

Procedures

Student Advisory Group.—During the semester prior to baseline, we formed a student advisory group with 14 members balanced on gender and race, and over-representing first-year students. The group had six meetings over the course of the semester, each with its own topic, including developing ideas for a project name, identity, and website; reviewing marketing materials and recruitment strategies; suggesting incentives and compensation frameworks; and evaluating survey methods and measures. One meeting was dedicated to providing input to a graphic design firm that designed our advertising materials and project logo. The facilitator used focus group methods including open-ended questions to encourage discussion, following emergent ideas and probing members for consensus or alternative thoughts. We frequently assigned homework to group members, including completing parts of the baseline survey and reviewing favorite websites to provide ideas.

Contact with campus stakeholders.—Multiple meetings were held with staff involved in the offices related to campus, residential, and student life. The social network methods employed in the present study had the potential to raise concerns about privacy and confidentiality, primarily because the survey asked the participants to select friend connections, self-report underage alcohol use, and report on the behaviors of others. We provided a brief single-page information sheet to all the relevant members of the administration and met with many in person to ensure they were familiar with the project goals so they could direct questions from students, parents, or administrators to the project investigators. During late-summer trainings for resident advisors in the first-year dorms, we held informational sessions to describe the study and gather impressions about potential barriers to first-year student participation. By providing information about the study to as many stakeholders as possible, we aimed to increase comfort about the study campus-wide. Since the stakeholders were much closer to the campus ecology and the perspective of first-year students, we also gathered valuable ideas about communication strategies and potential

concerns about participation that we could proactively address. None of these stakeholders were tasked with recruiting participants.

Website.—Early in the enrollment process, we built an informational website that contained project goals, a detailed description of what participation entailed, a page with "Frequently Asked Questions," extensive information about confidentiality of the research data, descriptions of the project investigators and staff with photos, and research study contact information.

Enrollment campaign.—Using a roster with contact information for eligible students provided by the University, students were contacted before their arrival at campus through mailed postcards, again when they were on campus with a second postcard, and through email. We also posted flyers, posters, and table slips at the main cafeteria, staffed information tables in central campus locations, and posted regularly on social media (Facebook, Instagram, and Twitter). All materials referred students to the study website. The email invitation contained a project description and a secure link to the project consent form. The consent form included an explanation of the complete study including the social network survey, and explicitly informed students that their names would be available for others to choose on a pulldown list of all students in the class unless they opted out of being on the list. At the end of the consent form, students could choose to enroll in the research or not to enroll. If they chose not to enroll they were given the option to allow their name to remain on the social network list or to opt-out of having their name on the list. If a student opted out after the survey began, all nominations of them and any associated data (i.e., other students' perceptions of them) were removed from the dataset. Students who chose to participate could not opt-out of being on the list. Students who did not respond (i.e., did not consent or opt out) remained on the network survey nominations list but were not surveyed themselves.

Students who were under the age of 18 at the time of consent provided assent using the same method, and were asked to provide an email or postal mailing address for a parent. For parent emails, our web-based system automatically sent information to the parent containing project information and a consent form link. We first showed the students the text of the email that would be sent to their parents, and students were able to personalize the beginning of the email to their parents, which then was sent automatically from the student's email address. When a parent provided consent, our system automatically sent an email containing the survey web link to the student and informed them that their participation could begin.

Surveys.—The baseline survey was administered using web-based software (Illume version 5.0; DatStat, Inc.) with customized survey components for collecting social network ties. Participants were encouraged to complete the survey in one sitting but could return to the survey at another time. The survey was open for two weeks at the end of October 2016, six weeks into the fall semester.

Incentives.—The project used three types of incentives. We provided enrollment incentives, in the form of a small gift (a choice of a water bottle or a t-shirt with the project logo) sent at the time of enrollment, and emailed Amazon gift cards as compensation for

survey completion ($50). BMI participants received $35 cash for completing the BMI intervention and post-intervention measures (not described here).

Measures

Demographics.—Age, birth sex, gender identity, race/ethnicity, financial aid status, and intercollegiate athletic participation were collected from participants. Room location and the location of substance-free floors (used to code participants living on such floors) were obtained from the university. Students could request to live on a substance-free floor prior to dorm assignment; students living on a substance-free floor agree not to use substances in the dorm or to be under the influence of substances while in the residence hall.

Alcohol use and related consequences.—The following definition of a standard drink and an image of typical drinks accompanied alcohol use items: 12 oz. of beer, 5 oz. of wine or 1.5 oz. of 80 proof liquor. Past 30-day alcohol use was assessed with the item “In the past 30 days on how many days did you have at least one drink of any alcoholic beverage?” and dichotomized to reflect any drinking. Heavy drinking was assessed by asking, “Considering all types of alcohol beverages, how many times during the past 30 days did you have four/five or more drinks in one occasion?” Four or five standard drinks was presented to participants of female or male birth sex, respectively, and this item was dichotomized for the current report. The number of standard drinks consumed on a typical drinking day was measured with the question, “In the past 30 days, on the days when you drank, how many drinks did you drink on average?” Average number of drinks per week was calculated using participants’ self-reported number of drinking days and number of drinks per drinking day. The Brief Young Adult Alcohol Consequences Questionnaire (Kahler, Hustad, Barnett, Strong, & Borsari, 2008; Kahler, Strong, & Read, 2005) is a 24-item measure that asks participants to indicate whether they had experienced each consequence because of drinking in the past 30 days. Examples of items include: “I have felt very sick to my stomach or thrown up after drinking” and “I have woken up in an unexpected place after heavy drinking.” Items have a dichotomous (no/yes) response choice and are summed for a total score. Cronbach’s $\alpha = .82$ in this sample.

Network survey.—The network survey was modeled after the Important People Instrument (Longabaugh & Zywiak, 2002). Participants were asked to identify individuals in the first-year class “who have been important to you in the past month.” Participants provided the person’s first name and the first initial of the person’s last name, then were presented with a pulldown menu containing all the students in the first-year class (except those students who had opted out). The menu had an auto-complete function; it presented participants with names that matched what they were typing allowing them to rapidly select their classmate. Prior to the survey launch, all students were assigned an ID number, which allowed for the presentation of names only on the pulldown names menu, but stored selections only by ID in the dataset. Participants could make up to 10 nominations. This instrument created *directed ties* for the relationships it measures; that is, for two individuals A and B, a tie could be: A chooses B, B chooses A, they both choose each other or neither of them chooses the other.

We describe the full network by calculating the number of ties between participants, density, and transitivity. Density is the proportion of observed ties over all possible ties and reflects overall connectivity within the network. Transitivity measures the proportion of times in the network that all ties within a possible triad are observed. A complete triad is observed when person A shares a tie with person B and person C, and person B and C share a tie as well, regardless of the direction of the tie. In the complete network, this is calculated for all possible combinations of three individuals, and is a measure of network closure; the higher the proportion, the greater embedding within local ties.

Five measures of network embedding also were calculated for each individual from the nominations in the network survey. (1) Indegree is the number of nominations a participant received from others in the network and reflects prestige or popularity. (2) Outdegree is the number of nominations made by a participant and reflects expansiveness or sociability. (3) Mutuality (reciprocity) is indicated by the proportion of an individual's directed ties (in ties or out ties) that are bidirectional and reflects the extent to which participants choose each other. (4) Eigenvector centrality reflects one's central position in the overall network (i.e., not within the BMI/NHC group specifically), and is calculated as a normalized sum of the participant's ties (where all ties are treated as undirected), weighted by the (similarly weighted) ties of those friends. This can be thought of as an indicator of how popular each person's friends are, so it reflects global popularity or overall centrality within the entire network. (5) Ego density is a transitivity value calculated for each individual (i.e., each "ego"), which indicates the closure in participants' personal networks, measured as the proportion of possible ties among each person's nominations that are complete (i.e., of the people a person is tied to, what proportion of directed ties exist between them). The number of possible ties is calculated as $n \times (n-1)$ where n is the number of ties that a participant has. For example, if a participant has eight friends, each of those eight friends has seven ties they could be connected to within the participant's ego network (not counting the participant) and we calculate the possible number of directed ties among individuals in the ego network as $8 \times 7 = 56$. The higher the value, the greater the closure in a person's network. Network characteristics were calculated in R and in some cases using the SNA package (version 2.2-0; Butts, 2010).

Data Processing and Analysis

Response checking.—Survey flow was designed to improve question response validity. Participants were branched only to questions that were relevant for them (e.g., we did not administer questions about drinking-related events to participants who had not reported drinking). Participants were prompted if they answered a question in a way that was inconsistent with an answer on a previous question (e.g., if their number of drinks and number of heavy drinking days reports were inconsistent). Participants were not forced to answer any items, but if they skipped an item they were prompted with a reminder that they had not answered a question – this served to catch accidental missing responses, and to reduce the benefit of shortening the survey by purposely skipping items. Following data collection, we identified rushed or inattentive responding by checking for "straightlining" of measures (i.e., always answering the same response on a survey) and identified participants who completed the survey in less than 20 minutes and/or answered fewer than 96% of items

that were presented to them (reflecting 3 SDs above the mean). We also reviewed open-text answers for atypical responses (e.g., nonsense words). Responses of participants who showed the above response patterns were reviewed closely (Osborne, 2013), and problematic measures removed. In 14 cases we found problematic responses that resulted in the removal of self-reported behavioral data. Four additional participants did not report on their alcohol use, resulting in 17 cases with missing self-reported alcohol use data.

Missing network data.—One decision that must be made when a network is incomplete (i.e., not all network members are observed), is what to do with incoming nominations to individuals who were not themselves observed (i.e., were not participants of the study). In the present study, this occurred when participating students nominated peers within the network survey who did not themselves participate. Most network characteristics cannot be calculated for these missing cases since we do not have a record of the ties that they would have declared if they had participated; furthermore, no other information was available for these nonparticipants (i.e., self-reported demographics and behavioral reports). Because network embedding measures are minimally affected by missingness in studies with at least 80% response rates (Huisman & Steglich, 2008; Kossinets, 2006), a criterion met in this study, we did not include ties to nonparticipants in analyses. However, we did include the network data for participants whose behavioral data was removed, since this allowed us to more completely represent the network structure.

Analyses.—For this paper, we used chi-square tests, t-tests, and regression to determine relationships between (BMI vs. NHC) group membership and participant characteristics including demographics, alcohol use, and network characteristics. A significant between group difference on race was followed by post-hoc comparisons.

For the overall trial, we plan to first use Generalized Estimating Equations (Zeger & Liang 1986) to determine the direct effects of the intervention (i.e., between those in the BMI who received the intervention vs. their controls in NHC). Stochastic Actor Oriented Models (Snijders, van de Bunt, & Steglich, 2010) will be used to investigate the indirect intervention effect – that is, whether there is a behavioral difference between those in the BMI group who did not receive the intervention and their controls in the NHC group, and whether that difference can be attributed to exposure to BMI recipients. Our primary endpoints for both sets of analyses are alcohol use and alcohol-related consequences as described above. Baseline values for the outcomes and demographic characteristics that are significantly related to the endpoints will be included as covariates. The alpha (Type I error) for all analyses will be .05.

Power and sample size.—The primary interest in this trial is to determine whether the alcohol-related behavior of BMI intervention recipients' heavy drinking peers is reduced. There is very little guidance for quantifying this type of transmitted effect. We expect that the size of the effect on the network (i.e., heavy drinking peers) will be smaller than the effect size for intervention recipients because the effects will likely be diluted as they are transmitted. Assuming a starting point of the direct effect size from prior work of Cohen's *d* =.60 (Borsari & Carey, 2000; Butler & Correia, 2009; Carey, Carey, Maisto, & Henson, 2006; Murphy et al., 2001; Walters, Vader, Harris, Field, & Jouriles, 2009), a 25%, 50%, and

75% reduction in the effect upon the transmission to network peers would result in effect sizes of .45, .30, and .15, respectively (p = .05, power = .80). The smallest of the sample sizes at follow up is in the BMI group with 328 participants (96.5% retention at 12-month follow up, data not shown). A sample size of 328 per group, which we have met or exceeded in the groups in this trial, would require an effect size of d = .23 to be significant. Therefore, we would have the necessary power to detect the indirect intervention effect, assuming between one quarter and one half of the behavior change of intervention recipients is transmitted to other heavy drinkers.

3. Results

Baseline enrollment was 1,342/1,660 (80.8%), with 49 (3.0%) declining, and 42 (2.5%) of the decliners opting out of being included in the first survey.

Participants Compared to Nonparticipants at Baseline

Race, gender, age, and residence on a substance-free floor were available from the original roster of students; from this we determined that at baseline women (83.4%) were more likely to enroll than men (77.9%), p = .005, nonwhite (82.7%) were more likely to enroll than white (78.3%), p = .02, and Hispanic individuals (86.8%) were more likely to enroll than non-Hispanic individuals (80.0%), p = .02, respectively. There were no enrollment differences based on minor (77.8%) vs. adult (81.0%) age status or substance-free dorm floor residence (78.4% vs. not substance-free 81.2%) (ps > .05).

Network Information

The total number of network nominations at baseline was 7,510, for an average number of ties made per participant of 5.6 (SD = 3.0; Median = 6; range 0-10)[1]. Of the 1,342 participants with social network data, 92 (6.9%) did not nominate any other participant. Twenty participants (1.5%) were not nominated by any other participant. The network formed five components (i.e., clusters of connections): a primary component containing nearly all participants (n = 1337), one dyad, and three isolates (see Figure 1). The density of the network was 0.004, which means that .4% of possible ties were made. Network transitivity was 25.8%, indicating that about one in 4 possible triads was complete.

Intervention Recipients

We targeted 25% of heavy drinkers (defined as having two or more heavy drinking episodes in the past month) in each of the two groups to identify intervention recipients. In applying our algorithm, we over-selected (at 27%) intervention recipients to account for some nonresponse to the BMI sessions. This resulted in 70 participants selected for the BMI group and 72 selected for the NHC group (see Figures 2 and 3). These participants were generally representative of the other heavy drinking participants, with some minor differences (Ott et al., Manuscript under review).

[1]At baseline, an average of 1.0 (SD =1.2) nominations were made of individuals who were not participants or whose identity was not provided. As is typical for social network studies, from this point forward, we refer only to ties made between study participants.

Between-Groups Comparisons

Table 1 contains analytic comparisons between the intervention (BMI) and control (NHC) groups.

Demographics.—There were no statistically significant age, gender, financial aid, first-generation, or intercollegiate athlete status differences between the intervention and control groups (*p*s > .05). Two demographic differences were found; there were more Non-Hispanic Asian participants in the NHC group and more Non-Hispanic Black participants in the BMI group. There were also more participants who lived on substance-free floors in the NHC group. Further exploration revealed a significant relationship between race/ethnicity and living on a substance-free floor, $p < .001$, with a lower proportion of non-Hispanic white students living on substance-free floors (representing 51.7% of students in non-substance-free and 22.2% of students in substance-free, $p < .001$) relative to other race/ethnicity groups.

Alcohol use.—At baseline, there was higher drinking prevalence, heavy drinking prevalence, and drinks per week in the BMI relative to NHC group (see Table 1). When this analysis was conducted controlling for substance-free floor status, the differences for drinking prevalence (adjusted prevalence in BMI = 78%; NHC = 73%; $p = .06$) and heavy drinking prevalence (adjusted prevalence in BMI = 54%; NHC = 49%; $p = .11$) were not significant, although drinks per week was still significantly higher in the BMI group (adjusted Mean for BMI = 5.4; NHC = 4.3); $\beta = .07$, $p = .005$. Drinking consequences were measured only among those who reported past 30-day alcohol use, and were not significantly different between the BMI and NHC groups.

Network characteristics.—Indegree, outdegree, ego density (i.e., closure in one's close network), and mutuality (the proportion of ties that were mutual between the participant and his/her ties) did not differ between groups. Eigenvector centrality (an indicator of global popularity) was higher in the NHC group. Again, we included substance-free (dorm) as a covariate, and found a reduced but still significant relationship between intervention group and eigenvector centrality, $\beta = -.07$, $p = .014$.

4. Discussion

The purpose of this paper is to describe the design and methods for a controlled trial investigating the indirect effect of a brief motivational intervention; we presented the recruitment, enrollment, and assessment of a large proportion of a complete class year of college students. For network studies, it is critical that a large proportion of the network be observed, and we were successful in enrolling 81% of a first-year residential college class at baseline. We used a student advisory group, a campus-wide enrollment campaign with multiple sources of information for participants (web-based, direct communication, marketing methods), communication with stakeholders (resident advisors, residence life, campus life), and an incentive structure that compensated enrollment and survey completion.

When asked to provide up to 10 ties, participants nominated, on average, between 5 and 6 others as people in their class year who were important to them, and only 34% nominated

10, suggesting that this limit did not lead to an undue number of “false negative” ties (Marsden, 2011). Mutuality of ties was 37%, indicating moderate dyadic agreement among individuals’ relationships. The more mutual ties, the more evident the relationship is to both individuals, and thus the more mutual ties an individual has, the greater strength or closeness between ties in his/her close network (Valente & Vlahov, 2001). Ego density provides additional information about close ties, and about 1 in 4 possible ties among egos’ alters were present. In summary, the network in its initial formation (i.e., within six weeks of matriculation at college) reflected moderate network closure and mutuality.

Because of the nature of the study in which isolation of the intervention effect was desired, we intentionally did not randomly assign students to condition; we used the geographical location of dormitories on campus to define the two conditions. A larger proportion of floors designated as substance free were located in the control (NHC) dorms, which may be related to this group having a lower proportion of drinkers and heavy drinkers vs. the intervention group. Differences remained to some extent even after controlling for substance-free residence status, including higher drinks per week, a somewhat trivial lower relationship mutuality (i.e., agreement that a relationship exists) and lower eigenvector centrality (i.e., global popularity) in the BMI group, which are differences that may require statistical control to properly evaluate intervention effects.

Limitations

There are limitations to this study that should be acknowledged. For instance, although the enrollment and low missing data suggests that the overall study design was quite successful, we are unable to determine which specific elements of the design were most critical to the enrollment success. Informally, however, we believe that the underlying principles of openness and partnership with participants played a significant role in achieving data collection goals. Such a conclusion is a reassuring sign that even quite sensitive data (e.g. pertaining to drug and alcohol use and close social relationships) can be obtained ethically and with full disclosure of relevant facts, especially in light of increasing concerns regarding the privacy of personal data available on, for instance, social media.

Given that the goal of the study was to evaluate the indirect effect of an individual intervention, it was important to isolate the transmission of behavior change within each group to the extent possible, so we decided to assign participants to intervention condition according to where they lived on campus. The design therefore required non-randomization, but resulted in a group difference in substance-free dormitory floors that accounted partially for group differences in alcohol use and network characteristic differences, although these differences may arguably turn out to be of little relevance. Even so, such idiosyncrasies will need to be addressed in studies conducted on other campuses. Finally, this investigation was conducted at a medium-sized private university in the northeastern US, and the enrollment campaign methods and data collection procedures might not result in similar outcomes at other institutions.

Conclusion

We believe this is the largest complete social network study to date conducted among college students. Multiple methods were used in the enrollment campaign, including advertisements, in-person contact, and an active social media presence. Our approach emphasized openness, disclosure, and the partnership nature of the relationship between the research team and study participants. The outcome was a complete network of a college class surveyed with excellent enrollment, with informative data on alcohol use and social network characteristics.

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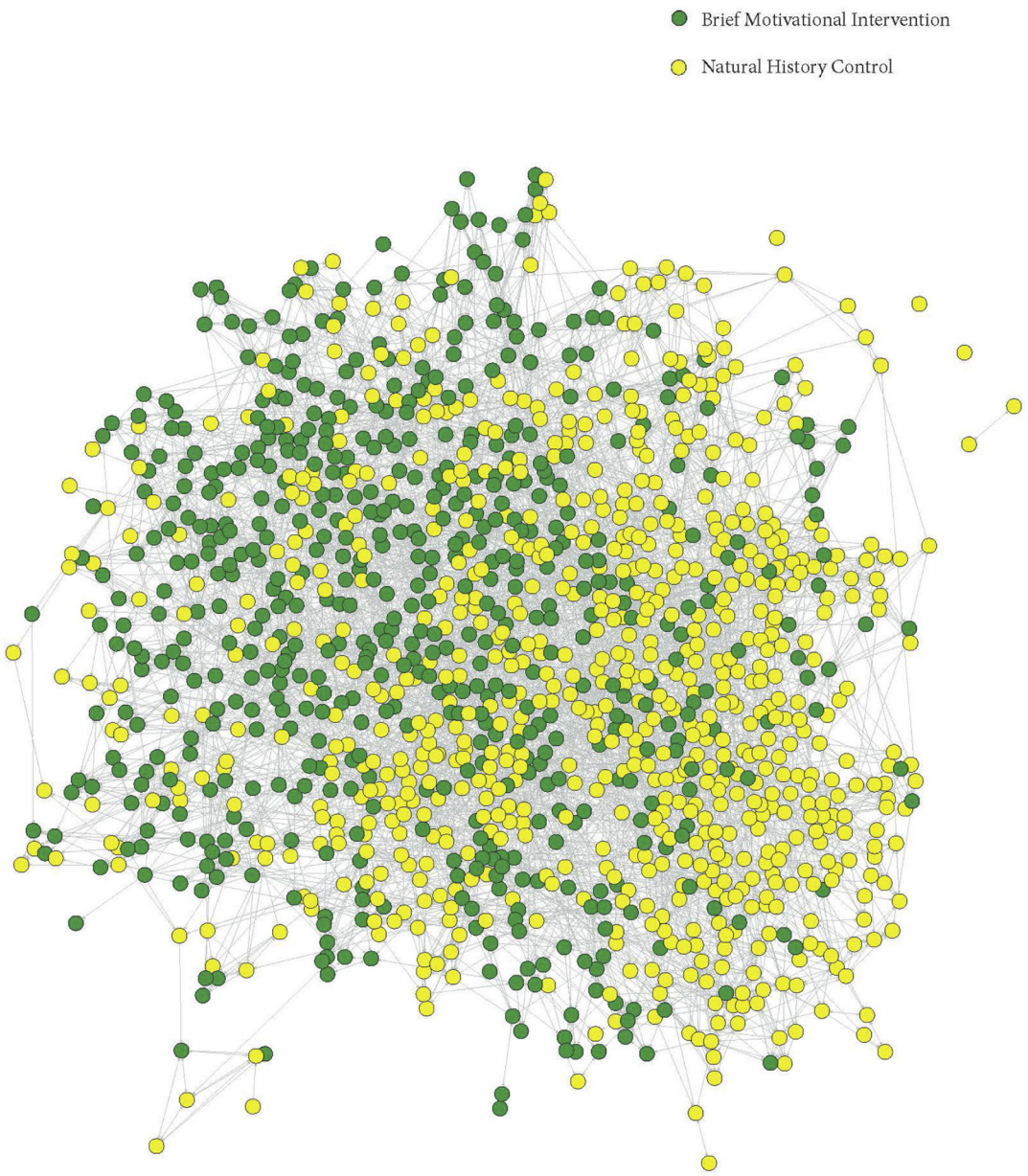

Figure 1.
Sociogram of the First-year College Student Network at Baseline (N = 1342)

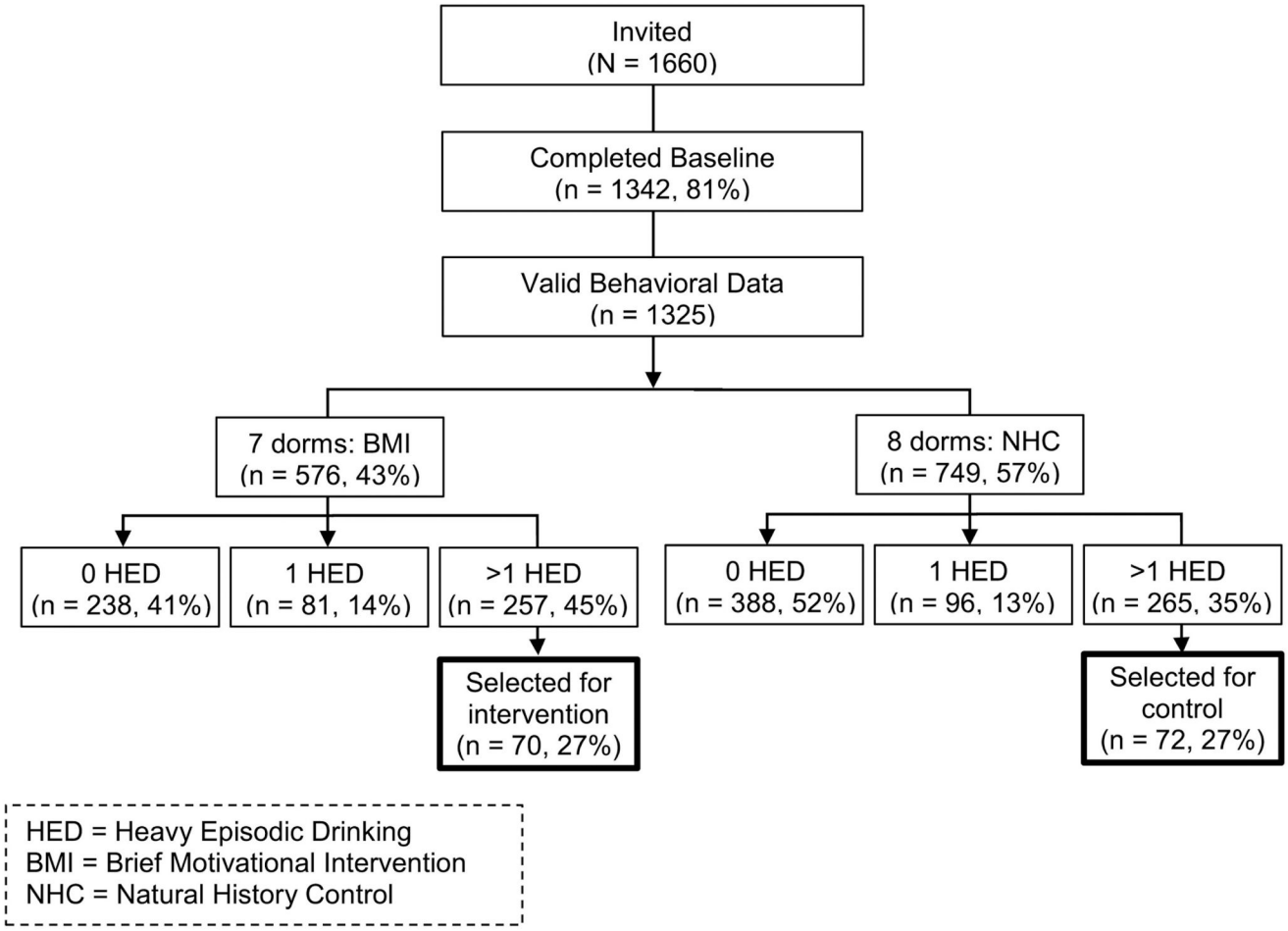

Figure 2.
Flow Chart of Participant Enrollment and Baseline Data Collection

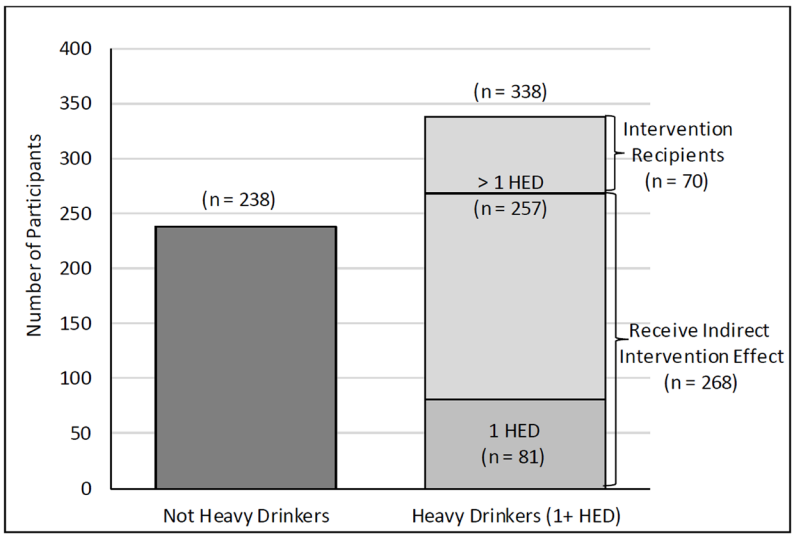

Figure 3.

Participants in the BMI group. Intervention recipients were chosen such that 25% of higher frequency heavy drinkers (more than one heavy drinking day in past month), would receive BMI (27% were selected, anticipating some non-completion of the BMI). Those not selected from the higher frequency group and other heavy drinkers (those with one heavy drinking day) received no direct intervention. The same process was used for the NHC group (not shown).

Table 1.

Demographic, alcohol use, and network characteristic differences between intervention conditions.

Variable	All *N*(%) or *M(SD)*	NHC (*n* = 749)	BMI (*n* = 576)	*p*
Demographics				
Age	18.6 (0.51)	18.6 (0.52)	18.7 (0.49)	.10
Birth sex				.34
Female	732 (55.3%)	424 (56.7%)	308 (53.5%)	
Male	592 (44.7%)	324 (43.3%)	268 (46.5%)	
Gender identity				.58
Female	722 (54.5%)	417 (55.7%)	305 (53.0%)	
Male	586 (44.2%)	322 (43.0%)	264 (45.8%)	
Different identity	17 (1.3%)	10 (1.3%)	7 (1.2%)	
Race/Ethnicity[a]				.01
Hispanic/Latino/a	200 (15.3%)	109 (14.7%)	91 (15.9%)	
Non-Hispanic White	625 (47.7%)	338 (45.7%)	287 (50.2%)	
Non-Hispanic Asian	297 (22.7%)	192 (26.0%)*a*	105 (18.4%)*b*	
Non-Hispanic Black	82 (6.3%)	38 (5.1%)*a*	44 (7.7%)*b*	
Multiracial	107 (8.2%)	62 (8.4%)	45 (7.9%)	
Receiving financial aid	624 (47.1%)	350 (46.7%)	274 (47.6%)	.76
First generation college	220 (16.6%)	127 (17.0%)	93 (16.1%)	.69
Intercollegiate athlete	183 (13.8%)	93 (12.4%)	90 (15.6%)	.09
Substance-free floor	180 (13.6%)	147 (19.6%)	33 (5.7%)	< .001
Alcohol Use				
Any drinking in past month	971 (73.3%)	513 (68.5%)	458 (79.5%)	< .001
Any heavy drinking (4/5+) in the past month	699 (52.8%)	361 (48.2%)	338 (58.7%)	< .001
Drinks per week[b]	4.8 (6.3)	4.1 (5.5)	5.7 (7.1)	<.001
Alcohol Consequences[c]	3.8 (3.4)	3.6 (3.4)	3.9 (3.4)	.17
Network Characteristics				
Number of in-ties	5.6 (3.1)	5.5 (3.1)	5.7 (3.1)	.52
Number of out-ties	5.6 (3.0)	5.6 (3.0)	5.7 (2.9)	.66
Mutuality	36.5 (22.2%)	37.6 (22.6%)	35.1 (21.5%)	.05
Eigenvector centrality (z-score)	0 (1.0)	.014 (.031)	.008 (.013)	< .001
Ego density (proportion)	21.0 (16.7%)	20.4 (16.6%)	21.7 (16.6%)	.17

[a] 14 participants (1.1%) reported another race or did not answer.

[b] Log transformed for analyses.

[c] Measured only among drinkers.

Note. BMI = Brief Motivational Intervention; NHC = Natural History Control. Subscripts denote subgroups that differ significantly between columns.