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Examining the Effect of Friends' Drug Treatment on One's Drug Use: Investigating Positive
Peer Influence in the National Longitudinal Study of Adolescent to Adult Health

Dallin C. Everett

A thesis submitted to the faculty of
Brigham Young University
in partial fulfillment of the requirements for the degree of
Master of Science

John Patrick Hoffmann, Chair
Cory B. Dennis
Lance David Erickson

Department of Sociology
Brigham Young University

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ABSTRACT

Examining the Effect of Friends' Drug Treatment on One's Drug Use: Investigating Positive Peer Influence in the National Longitudinal Study of Adolescent to Adult Health

Dallin C. Everett
Department of Sociology, BYU
Master of Science

Peer influence is a well-studied and established phenomenon in the social sciences with much research focusing on peers influencing one another in negative ways. However, peers have also been shown to provide a positive influence. Research on substance treatment programs indicates that one's social network can influence one to enter treatment as well as help maintain abstinence following the completion of the program. However, little is known about the influence that peer's drug treatment can have on the substance levels of an individual. I use the peer nomination data and Waves 1 and 2 of the National Longitudinal Study of Adolescent to Adult Health to study this instance of peer influence. Results indicate that having a higher proportion of peers who attend drug treatment is not associated with lower levels of respondent illicit drug, alcohol use, and binge drinking behaviors. Consistent with past findings, having a higher proportion of one's peers who reported drug use is associated with higher levels of respondent substance use. Implications for clinicians and other treatment providers are discussed with an emphasis on the role that strong parental attachment can play in offsetting negative peer influence.

Keywords: peer influence, adolescent illicit drug use, adolescent alcohol use, peer drug treatment

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Examining the Effect of Friend's Drug Treatment on One's Drug Use: Investigating Positive Peer Influence in the National Longitudinal Study of Adolescent to Adult Health

The influence that peers have on one another is a well-studied phenomenon in the social sciences. The behaviors of those in one's social network have been observed in a number of instances to influence one's own behavior (Christakis and Fowler 2008a; Davey et al. 2007; Havassy, Hall, and Wasserman 1991; Litt, Kadden, and Tennen 2015; Longabaugh et al. 2010). Peer influence has been observed among both adolescents (Frank et al. 2011) and adults (Broome, Simpson, and Joe 2002). Although the support received from one's social network can be a powerful influence in helping a person change his or her own behaviors (Hunter-Reel, Witkiewitz, and Zweben 2012), the larger the proportion of peers who participate in similar activities may also be a powerful influence on the behavior of an individual (Haynie 2002).

Much of the previous literature on peer influence and social networks in the field of criminology has focused on one's peers encouraging and influencing participation in criminal and delinquent activities (Baerveldt and Snijders 1994; Havassy et al. 1991; Longabaugh et al. 2010; Reid et al. 2015; Schroeder et al. 2001; Urberg, Degirmencioglu, and Pilgrim 1997). For example, when adolescents associate with deviant peers they tend to exhibit higher rates of crime, substance abuse, and dependence (Fergusson, Swain-Campbell, and Horwood 2002). Additionally, best friends affect the initiation of cigarette and alcohol use (Urberg et al. 1997) and those who have more drug users in their social network are less likely to decrease their own use (Ali and Dwyer 2010; Reid et al. 2015). These results provide clear evidence that there exists a negative side to social networks and the influence that peers can have on one another.

However, one's peers have been shown to be beneficial in a number of instances, such as in the transmission of culture (Adler and Adler 1995), obtaining employment (Granovetter 1973), and even successful outcomes following drug treatment (Hunter-Reel et al. 2012).

Kadushin (2012) points out that one's social network can exert a positive influence on individuals and are important to the diffusion of information and resources. A number of behaviors seem to be strongly influenced by and even spread through social networks, such as mathematic course taking among high school students (Frank et al. 2011), obesity reduction (Christakis and Fowler 2007), and smoking cessation (Christakis and Fowler 2008a, 2008b). For example, research indicates that when it comes to smoking cessation close friendships tend to be the most influential in quitting compared to more casual relationships (Christakis and Fowler 2008a). These collective results provide strong evidence of the benefits realized through peer influence. Such results show a positive side to peer influence that is often ignored by criminologists.

Substance use, especially among teenagers, is a pressing issue that requires the attention of researchers and policy experts alike (Gilvarry 2000). For those adolescents who abuse substances, research indicates that drug treatment may lower substance use levels (Williams and Chang 2000). Although drug treatment has been shown to lower use levels, relapse rates for adolescents receiving drug treatment are high (Brown, Vik, and Creamer 1989; Cornelius et al. 2003). Social influence is a common reason for relapse among adolescents (Brown et al. 1989; Chung and Maisto 2006), suggesting that although individuals are often encouraged during drug treatment to reduce or eliminate associations with substance using peers, many continue to interact with similar peers following treatment.

Scholars typically examine peer drug use and networks of users to study the impact they have on an individual's drug use behaviors. A side of social networks and peer influence that has not received much attention in the literature is how attending drug treatment affects other members of an individual's social network. Research suggests that entry into drug treatment

programs may be influenced by those in one's social network (Davey-Rothwell, Kuramoto, and Latkin 2008; Davey et al. 2007). Similarly, Rees and Wallace (2014) observe that in an alcohol consuming group of adolescents, a group minority of non-drinkers can influence the group majority to reduce alcohol consumption. These results show that the behaviors of individuals can affect the behavior of other members of their network, resulting in positive changes in the behaviors of their peers. Indeed, recent work on the diffusion of the effects of a drug prevention intervention indicate that individuals who have friends who participate in the intervention, but do not participate themselves, may also realize the benefits of the intervention (Rulison, Feinberg, et al. 2015; Rulison, Gest, and Osgood 2015). Yet, examining whether drug treatment among network members affects one's own drug use has not been carefully examined.

Thus, the purpose of this study is to extend the research on peer influence by determining whether one's drug use is lower as the proportion of one's peers who attend drug treatment is higher. If such an effect is observed, it could potentially allow treatment personnel to alter treatment and/or delivery to additionally target one's peers, thereby extending the benefits of treatment to multiple individuals. Furthermore, treatment programs or other interventions may seek to target multiple members of a peer group, thus allowing peer influence to come from multiple sources.

After providing additional justification for studying the potential effects of peer drug treatment, I use data from the National Longitudinal Study of Adolescent to Adult Health (Add Health) to test a series of linear regression models designed to determine whether the proportion of one's peers who attend drug treatment is associated with one's own drug use. The models adjust for the effects of peer drug use, respondent drug use, respondent drug treatment, parental attachment, and demographic factors. After discussing the implications of the results, I provide

several suggestions for how this research might be used to improve drug abuse intervention and treatment programs for adolescents.

LITERATURE REVIEW

Social Networks and Influence

A number of phenomena, including ideas, attitudes, and behaviors, are transmitted through social networks. Both traditional and viral marketing rely heavily on social networks to transmit information about products and ideas to potential customers (Kempe, Kleinberg, and Tardos 2003). The more influential individuals are in their network, the more likely ideas may spread quickly to other members of their network. Some members of a network may be more influential than others and act as brokers passing on information to others (Kadushin 2012). For instance, Bakshy et al. (2012) used an experimental design to determine how information is diffused throughout a network of Facebook friends. As expected, those who were exposed to the sharing behaviors of their friends passed on information quicker than those who experienced no exposure. Furthermore, as more individuals in one's network shared information, it became more likely for other participants to pass on the information. Such results show that one's network is important in the transmission of information to the other members of one's network and that as more members of a group engage in a behavior they may be more influential than just a single member. By subsequently sharing information that the participant's friends had shared, the participant's behavior was influenced by others in his or her network. This shows that individuals can be influenced by others in their network and that both influence and ideas can travel through the members of a social network to other individuals.

Influence can come from a variety of sources and can affect a number of behaviors. Even though influence is often thought to move from groups to individuals, individuals can influence

their peer groups (Barlow and Kauzlarich 2010). In some instances, groups may be more influential, whereas in other situations, close relationships (such as best friends) may provide more influence (Urberg et al. 1997). For example, in a study of initiation of cigarette and alcohol use, Urberg et al. (1997) report that best friends are most influential. However, when investigating the transition into the adolescent's current use levels, peer groups are more influential than best friends. Some behaviors, then, may be more strongly influenced by close friends, yet others by groups of peers.

Close relationships, such as friends, provide a strong source of influence. Through a series of studies focusing on the obesity epidemic as well as smoking cessation, Christakis and Fowler (2007, 2008a, 2008b) compare the effects of influence based on geographic distance between individuals with to social distance, or closeness between individuals. In all three studies, the authors conclude that closeness between individuals exerts greater influence than does physical distance. Therefore, being socially closer together—when people have strong relationships with one another—rather than how far apart they are physically, is most important in influencing behavior. These results show the importance that close relationships have in influencing behavior. The closer the relationship between individuals, the more the relationship itself is able to influence those involved.

Negative Peer Influence

In some cases, the influence exerted by peers leads individuals to participate in negative behaviors. Indeed, research has shown that those who have peers who use or abuse substances are more likely to use or abuse substances themselves (Ali and Dwyer 2010; Havassy et al. 1991; Prinstein, Boergers, and Spirito 2001; Rosenquist et al. 2010; Schaefer, Adams, and Haas 2013; Schroeder et al. 2001; Tucker et al. 2014). Furthermore, the collective results from this research

indicate that peers can influence one another in several negative ways. For example, using network data from the National Longitudinal Study of Adolescent to Adult Health (Add Health) Ali and Dwyer (2010) observed that the likelihood of an individual drinking increased by more than 2% when there was an increase of 10% in drinking among an individual's close friends. Not only do individuals tend to gravitate towards others like themselves, they also influence those around them.

One of the strongest predictors of substance use is having friends who also use substances. Several studies report that substance use in one's network predicts one's own substance use (Prinstein et al. 2001; Schaefer et al. 2013; Schroeder et al. 2001). Prinstein et al. (2001) indicate that involvement with friends who engage in risk behaviors increases the likelihood of one also participating in similar behaviors. Furthermore, the influence that others exert may increase as the popularity of users increases. For instance, more popular individuals tend to be more influential towards others in their social network (Schaefer et al. 2013) whether such influence is intentional or not (Kadushin 2012). Additionally, the influence of peers to engage in and continue using substances appears to be more powerful than environmental factors (Schroeder et al. 2001). There is little question as to the influence that peers can exert on one another to participate in substance use behaviors and other criminal or delinquent behaviors. From the examples given, peer influence in these instances leads to participation—both initiation and continuation—of substance using behaviors.

Social Networks and Relapse

Consistent with evidence indicating that peers influence one another's substance use (see, Ali and Dwyer 2010; Fergusson et al. 2002; Havassy et al. 1991; Prinstein et al. 2001; Rosenquist et al. 2010), research into drug treatment outcomes suggests that one's social network

is a major contributing factor to unsuccessful outcomes and relapse (Broome et al. 2002; Carroll and Onken 2005; Havassy et al. 1991; Kelly et al. 2014; Wasserman, Stewart, and Delucchi 2001). In fact, after assessing the results of a 12-step program for young adults, Kelly et al. (2014:4) report that “the number of high-risk friends and low-risk friends were found to be strong predictors of substance use outcome.” In particular, those who participated in this program and had more high-risk friends in their network were less likely to realize the benefits of the program and abstain from use. These results support the findings of Wasserman et al. (2001) who find that higher numbers of drug users in one’s network were also associated with poor treatment outcomes. When individuals receive drug treatment but retain high-risk or drug using members in their network, they are susceptible to the influence of these individuals and are more likely to fail to realize the benefits of drug treatment. In general, having drug using peers in one’s network can negate the expected benefits of drug treatment for individuals.

Furthermore, relapse following drug treatment may also be more likely when individuals do not receive positive social support (for example, pro-abstinence support) from their network and if they continue to live with current drug users (Broome et al. 2002). Studies indicate that close, pro-use relationships are associated with increased risk to relapse. Therefore, coupled with the results from Kelly et al. (2014), a person attending drug treatment who continues to have close relationships with drug users following treatment may be more likely to relapse. Again, we see the negative influence that peers exert on one another, especially when the relationship is close.

An important consideration to take into account when looking at the negative influence of peers in preventing relapse is the strength of the relationship between the individual and his or her peers. Not all relationships are equal and the strength of relationships varies among

individuals (Kadushin 2012). The results of several studies indicate that closer relationships are more influential in changing behavior compared to other relationships (Christakis and Fowler 2007, 2008a, 2008b). In regards to substance use, research indicates that individuals may be 50% more likely to be heavy drinkers if they are directly connected to another person who is also a heavy drinker (Rosenquist et al. 2010). Therefore, individuals who maintain close relationships with drug users are more likely to relapse after drug treatment and are less likely to realize the benefits of their treatment.

Social Networks May Help Maintain Abstinence

Although one's social network has been shown to influence negative behaviors such as relapse following drug treatment, one's peers can also play an important role in promoting positive behavior change. Reviewing numerous types of behavioral therapies for drug use, Carroll and Onken (2005) report that engaging the client's social network during the treatment process may improve post treatment outcomes. They assert that such benefits may be realized because one's social network "can be a powerful predictor of change" (p. 1455). Similarly, those with whom we associate influence our behaviors, and research on drug treatment shows that one's network may be helpful in improving post treatment outcomes (Mericle 2014). Therefore, treatments that involve members of one's social network (presumably those who are supportive of treatment) are likely to produce better results than those that do not. Not only would such treatments provide support for the individual seeking treatment, but also may strengthen ties with supportive members of the network.

Therefore, engaging peers in the treatment process who are supportive of the change and are pro-abstinence may also lead to better outcomes following treatment. Support and influence from such peers may further prevent relapse among those attending drug treatment. Research on

formal drug treatment strategies that involve members of the client's social network indicate that supportive peers and family members are important in helping promote and maintain abstinence (Copello et al. 2002, 2006; Galanter et al. 2004). Additionally, Hunter-Reel et al. (2012) report that individuals who identified a supportive significant other to participate in treatment realized better post treatment outcomes. During the treatment process, participants who had a supportive significant other who attended at least one treatment session subsequently drank less. The authors observed that the more sessions the supportive significant other attended, the less the participant drank at the end of the drug treatment. The results indicate that involving one's peers in the treatment process may help prevent relapse and lead to better post drug treatment outcomes, thus providing further evidence of the benefit that peer influence may have in some situations.

One's social network can increase the likelihood of positive post drug treatment outcomes (reduced use) and even abstinence (Hunter-Reel et al. 2012). Indeed, scholars believe that groups such as Alcoholics Anonymous (AA) or Narcotics Anonymous (NA) are effective for some individuals by encouraging them to associate with others who are supportive of their abstinence (Hunter-Reel, Witkiewitz, and Zweben 2012; Kelly et al. 2011, 2012, 2014). For example, changes in one's social network have been shown to primarily effect lowered alcohol use outcomes following AA group attendance (Kelly et al. 2012). Although these scholars are careful to point out that AA likely works through several processes, changes in one's social network appear to be the most important and influential component in preventing relapse. Furthermore, Min et al. (2013) observed network changes while women received drug treatment and suggest that such changes were likely the result of the participants spending more time with new individuals. Indeed, more frequent AA attendance is associated with reduced alcohol

consumption (Kelly et al. 2011). Such associations may be important in adding supportive individuals to one's network. In addition, an accompanying reduction in network ties to those who are resistant to drinking abstinence may be an important factor in preventing relapse. As noted previously, having high-risk or low-risk friends has been shown to strongly predict outcomes following drug treatment (Kelly et al. 2014). Although high-risk friends are associated with relapse and further drug problems, having higher numbers of low-risk friends is likely to lead to abstinence following drug treatment.

In general, then, although much of the criminological research addresses the negative effects of one's peers on behavior, it seems clear that social networks can also influence individuals in positive ways. This may include the influence of networks on reducing drug use and creating a more positive environment in which drug treatment is more effective.

LIMITATIONS OF PREVIOUS RESEARCH

Research on drug treatment and peer networks has examined how one's network influences the individual receiving treatment (Broome et al. 2002; Havassy et al. 1991; Hunter-Reel et al. 2012; Wasserman et al. 2001), but has not yet explored the effect of network members receiving treatment on one's drug use. A common limitation of research on drug treatment and social networks is that often only the individual involved in the study reports on the behavior of those in their social network rather than having all members report their own behavior (see, e.g., Broadhead et al. 2002; Davey et al. 2007; Hunter-Reel et al. 2012; Kelly et al. 2011, 2012, 2014; Min et al. 2013). Individuals, even in the same network, are likely to view situations, and even relationships, differently than others. Indeed, Bagwell and Schmidt (2011) indicate that there may be a discrepancy in how members of a network behave or view the relationship. Even friends have a tendency to view themselves as being more similar to one another than they

actually are (Urberg, Cheng, and Shyu 1991), and when children rate qualities of reciprocated relationships, correlations between individuals are observed to be quite low (Little et al. 1999). These results show that even friends do not always agree on aspects of their relationship. When individuals are asked to report on the behaviors of those in their network, respondents may very well be projecting their own behaviors onto the other members of the network, in particular believing that their peers are more similar to themselves than they may actually be.

There have been few studies that have overcome this general limitation. For example, several studies take advantage of the network data collected as part of the National Longitudinal Study of Adolescent to Adult Health (“Add Health”) which allows each respondent to list up to five of their best male and five female friends. Since many of the nominated friends also participated in the study, they report on their own behaviors, allowing for more accurate and in depth data on each member of the network. Rees and Wallace (2014) used these data to look at group minority influence and the effect that such individuals have on the drinking behaviors of their peers. Similarly, Ali and Dwyer (2010) used the network data from Add Health to better understand adolescent drinking behaviors. Other researchers have used similar methods but with different data (see, for example, Mercken et al. 2009, 2010). Such methods allow us to better understand the influence that peers can have on one another by having each member of the network report on his or her own behaviors.

THE CURRENT STUDY

The current study investigates the effect that peer drug treatment has on one’s own drug use levels. To my knowledge, no other study has investigated whether or not there is a carryover effect of drug treatment to other members of an individual’s social network. By potentially reducing the use levels of other members within one’s social network, society as a whole may

benefit. For instance, research suggests a connection between drug use and crime with many incarcerated individuals being arrested on drug charges (see Bennett et al. 2008; Darke et al. 2010). Therefore, reducing drug use in adolescence could result in reductions in criminal or delinquent activities later in life. Furthermore, interventions could be designed in such a way that the effects are not only meant to help the individual attending treatment, but also to help other members of the network.

The best approach to determine whether the effects of drug treatment diffuse or carryover to other members of ones' network is to use responses from each member of the network and not just from the one attending drug treatment. Kadushin (2012) indicates that influence is more effective when it comes from multiple directions. Therefore, peer groups where multiple individuals attend drug treatment are expected to also exert more influence on other members of the network. I examine the effect of drug treatment attendance among one's peers on one's own substance use. Specifically, this study tests the hypothesis that carry over effects of drug treatment occur and that substance use levels are lower among those with a higher proportion of their peers who attend drug treatment.

METHODS

Data

To examine the influence that peers who attend drug treatment have on one's substance use behaviors I use data from the Add Health study. The collection of the in-school data occurred during the 1994-95 school year. The data consist of a nationally representative sample of youth in the United States who were in grades 7 through 12 at the time of the study. The in-school questionnaire was administered to over 90,000 students and covered a range of topics such as social and demographic characteristics of each respondent, family information, friendships,

delinquency, drug use, and extracurricular activities. Each respondent was asked to identify their top five male friends as well as their top five female friends¹ using a school roster. A sub-sample was then taken from those who completed the in-school survey, resulting in approximately 20,746 individuals completing a more in depth survey (In-Home Wave 1) in 1995. The In-Home survey is supplemented by a parental questionnaire that provides more information about the families of the respondents such as family, home, and SES characteristics. Of those who participated in Wave 1, approximately 14,738 were again surveyed in 1996 (In-Home Wave 2). The final sample consists of only those who made at least one applicable peer nomination—for which there is data on their peer network—and who were interviewed again for the In-Home Waves 1 and 2 surveys. This resulted in an analytic sample of 9,032. As noted in Tables 3 and 4, though, the sample size varied between models due to slightly different patterns of applicable or missing data.

Achieving abstinence from substance use is more similar to a process than an event. The results of several studies suggest that cessation from substance use occurs over a period of time (Christakis and Fowler 2008a, 2008b; Kelly et al. 2014; Waldron et al. 2001). Therefore, I use two waves of data to capture this process.

Peer Networks

Peer networks are created using the peer nomination data from the In-School survey. Respondents were provided with a school roster containing the names of students in both the

¹ The sex of the respondent as well as the sex of the nominated peers potentially could be an issue in this study.

However, there is not adequate literature on same sex friendships and drug use to determine how respondents in the sample may be influenced by such relationships.

respondents' school and the sister school.² Respondents were allowed to nominate up to five male and five female friends, recording the identification number of each nominated friend on the survey. In some cases, a nominated friend did not appear on the school roster, did not attend the same school/sister school as the respondent, or was absent the day the survey was administered. For these nominations, respondents were asked if the nominated friend went to either the respondent's school or sister school, or if the friend went to a different school. In such instances, separate codes were used to differentiate these nominations from applicable ones. For the purpose of this study, these out-of-school nominations are dropped from the analysis as these nominated friends do not have data from the later In-Home surveys linked to them

In other instances, respondents opted not to nominate any friends and therefore did not have data regarding network drug treatment and drug use. Cases where no nominations were made are also dropped from the analysis. These respondents effectively reported a lack of a social network and did not report any direct ties to their peers. As a result, peer influence cannot be measured when no peers are nominated.

MEASURES

Outcome Variables-Respondent Drug and Alcohol Use

Respondent illicit drug use for the outcome variable was measured at Waves 1 and 2. A series of questions asked respondents to report how many times during the past 30 days they

² A sister school is defined as a "sample school in the same community as [the respondent's] school. If [the respondent] attends a high school, the sister school is generally the junior high or middle school that sends the majority of its students to [the respondent's] high school. If [the respondent] attends a junior high or middle school, the sister school is the high school [the respondent] is most likely to attend. If [the respondent's] school contains grades 7-12 there is not sister school" (Harris et al. 2009:4).

smoked marijuana, or used cocaine, inhalants, and other illegal drugs (such as LSD, PCP, ecstasy, mushrooms, speed, ice, heroin, or prescription pills without a prescription). I computed the mean of these items to construct a drug use variable. Mean illicit drug use at Wave 1 was 0.56 (SD=9.41) and at Wave 2 was 0.52 (SD=6.07).

Additionally, respondents reported their past 12-month frequency of alcohol use and binge drinking behaviors at Waves 1 and 2. To assess past 12-month frequency of alcohol use respondents were asked “During the past 12 months, on how many days did you drink alcohol?” Binge drinking is measured from the following question, “Over the past 12 months, on how many days did you drink five or more drinks in a row?” Responses for these questions were coded to reflect progressively higher levels of alcohol use, with values ranging from “never” to “every day or almost every day.” At Wave 1, 53% of respondents reported no alcohol use and 74.8% reported no binge drinking during the past year. Similarly, at Wave 2, 55.6% of respondents reported no alcohol use and 73% reported no binge drinking in the past year.

Due to the clustering of responses for all outcome variables at 0, a Breusch-Pagan test was used to check for heteroscedastic errors and revealed that heteroscedasticity was an issue in the models. Moreover, the residuals from the models suggested nonnormality. As a result, each of the outcome variables was transformed by logging (base e) the responses after adding one to each. This transformation is consistent with past methods and statistical techniques for dealing with highly skewed data (Hoffmann 2015; Moon, Blurton, and McCluskey 2008).

Control Variables

Network drug treatment

Drug treatment is measured using the Wave 1 In-Home survey. Respondents were asked “In the past year, have you attended a drug abuse, or alcohol abuse treatment program?” This

variable is coded dichotomously with “0” indicating respondents did not report drug or alcohol treatment in the past year and “1” indicating respondents reported they did attend drug or alcohol treatment in the past year. Responses from this question are merged onto the nominated friends from the In-School survey. I then created a variable to reflect the proportion of one’s friends who answered affirmatively to having attended drug treatment in the past year. Each respondent received a network drug treatment score ranging between 0 and 1 that reflects the proportion of their nominated peers who reported having been to drug treatment during the past year. Figure 1 provides an illustration of a measure of network drug treatment. Using the proportion of ones’ network versus a count of how many of one’s peers reported attending drug treatment is used for two reasons. First, using a proportion normalizes drug treatment attendance of one’s peers across the network due to variation in the number of peers a respondent nominated. Second, scholars argue that the proportion of one’s network that engages in a behavior may be more influential than the actual frequency or level of a behavior when such influence comes from multiple sources (Burt and Rees 2015; Haynie 2002; Kadushin 2012).

[Figure 1 about here]

Respondent drug treatment

Research indicates that attending drug treatment may lower an individual’s level of drug use (Hunter-Reel et al. 2012). Because of this effect, I control for whether or not the respondent reported having attended drug treatment. The variable for respondent drug treatment attendance comes from the same question used to create the network drug treatment measure. Respondents who did not attend drug treatment during the past year are given a score of “0” and those who reported drug treatment are given a score of “1.”

Network drug use

Since several studies indicate that peer drug use affects one's own use (Ali and Dwyer 2010; Prinstein et al. 2001; Rosenquist et al. 2010), I also measured the proportion of drug users among respondents' nominated peers. This measure is assessed using the same questions as those used for respondent drug use. However, to create a proportion peer network measure, responses for the drug use questions are dichotomized to reflect whether or not an individual reported using any of the substances or not rather than their level of use. The general drug use variable for each peer is coded as "0" if they had not used marijuana, cocaine, inhalants, or illegal drugs in the past 30 days or "1" if they had used any of these substances during the past 30 days.

A new variable reflecting the proportion of one's peers who use drugs was then created based on the responses from the peer general drug use variable. Each respondent in the sample received a network drug use score ranging between 0 and 1 reflecting the proportion of their network that reported drug use with higher scores indicating a higher proportion of their nominated friends having used drugs during the past 30 days (see Figure 2 for an illustration).

[Figure 2 about here]

A number of studies of adolescent drug use have found that socioeconomic status, sex, race/ethnicity, age, and parental attachment are associated with drug use frequency (Bachman et al. 1991; Bahr, Hoffmann, and Yang 2005; Goodman and Huang 2002; Hoffmann and Johnson 1998; Humensky 2010; Wagner and Anthony 2002) and may also affect the association between peer use and one's own drug use. Therefore, measures of each of these variables were included in the analysis.

Socioeconomic status

This variable was measured using the In-Home parent survey. Parental respondents reported their educational attainment ranging from having an “8th grade or less” level of education coded as “1” to “professional training beyond a 4-year college or university” coded as “9.” Where applicable, the parent also reported their partner’s educational attainment. Missing data was filled in using the student’s responses on parental education during the In-School and the In-Home Wave 1 survey. These responses were transformed to *z*-scores for both the responding parent and for their partner. Parents also reported their family income and these responses were also transformed to *z*-scores. I then created an SES variable by combining the mean educational *z*-score for both parent and partner with the *z*-score for reported family income to indicate family SES for the adolescent respondent. Lower scores on this variable represent lower socioeconomic status while higher values indicate higher socioeconomic status.

Sex and race/ethnicity

These variables are derived from the in-school survey. For the respondent’s sex, responses are coded “0” for females and “1” for males. Respondents were asked to indicate if they were white, black or African American, Asian or Pacific Islander, American Indian or Native American, or other. These responses are coded as “0” for no and “1” for yes, thus creating a set of dummy variables, with white as the omitted reference group in each of the models. During the In-School survey, respondents were allowed to choose more than one racial category. Multiple response answers were changed to reflect the answer given during the In-Home Survey in which respondents with multiple answers were asked to indicate which single category best described their race.

Parental attachment

The attachment that respondents have to their parents is assessed from the Wave 1 survey. Respondents were asked to indicate how close they feel to their mother (or mother figure), how much they thought their mother cared about them, how close they feel to their father (or father figure), and how much they thought their father cared about them. Responses for these questions range from 1 “not at all” to 5 “very much.” A general parental attachment variable was created taking the mean response of the four questions, with higher values indicating greater levels of parental attachment. Table 1 provides descriptive statistics for all the variables used in the analyses.

[Table 1 about here]

Analytic Strategy

Since ego drug use is a continuous variable, ordinary least squares (OLS) regression models were used to predict the level of drug use for Wave 1 outcome variables and to predict changes in drug use for Wave 2 outcome variables. The Wave 1 models included illicit drug use, alcohol use, and binge drinking at Wave 1 regressed on network characteristics and the control variables. Corresponding Wave 2 outcome variables are also regressed on network characteristics and control variables while also controlling for Wave 1 substance use to determine if any changes in drug use can be accounted for (Keele and Kelly 2006).

The explanatory variables were checked for multicollinearity using several tests. A correlation matrix reveals a strong correlation between the proportion of one’s network reporting illicit drug use and alcohol use (0.92). However, following the regression models, the *variance inflation factor* for both variables was 6.43, well below generally accepted cutoff levels (Hoffmann 2015).

As discussed previously regarding peer nominations, some respondents recorded at least one applicable peer nomination (at least one of their nominated peers went to the respondents school or sister school), some recorded nominations that were not applicable (all nominated peers did not attend either the respondents school or sister school, the names of peers did not appear on the school roster, or the nominated peer was absent when the survey was administered), and others did not make any peer nominations. Most respondents made at least one applicable peer nomination (79.5%) with respondents making an average of between 7 and 8 nominations.

Preliminary ANOVA analyses using Bonferroni correction compared various attributes between those respondents who made at least one applicable nomination, did not make any applicable nominations, and no nominations. The results from this analysis showed that significant differences exist between these groups in regards to SES, parental attachment, logged Wave 1 illicit drug use, logged Wave 1 alcohol use, and logged Wave 2 alcohol use. Respondents who made at least one applicable peer nomination reported higher levels of both SES and parental attachment compared to those who did not record any applicable nominations and those who failed to make any nominations. Similarly, respondents who made at least one applicable peer nomination also reported higher levels of logged alcohol use at Wave 1 and Wave 2 than those who did not make any nominations. However, those with at least one applicable peer nomination reported lower levels of logged illicit drug use at Wave 1 than both those who did not make any nominations, and those who did not make any applicable peer nominations. These groups did not significantly differ with regard to logged Wave 1 binge drinking, logged Wave 2 illicit drug use, and logged Wave 2 binge drinking. The results of the ANOVA analyses are presented in Table 2.

[Table 2 about here]

RESULTS

Descriptive statistics for the sample are presented in Table 1. Males make up the majority of the sample at 54.3% with females making up the remaining 45.7%. White was the predominant race/ethnic status in the sample (58.1%) followed by Black or African American (22%), Asian or Pacific Islander (9.3%), Other Race (9.3%), and American Indian or Native American (5.6%). The mean age for respondents in the sample is 14.98 (SD=1.7).

The mean socioeconomic status level for respondents was 0.02 (SD=0.8). Parental attachment ranged from 1-5 with higher values indicating higher levels of parental attachment. The mean for this variable was 4.63 (SD=0.55) indicating that on average, participants experienced high levels of attachment with their parents.

Few respondents reported having been to drug treatment during the past year (2.1%). Mean logged drug use at Wave 1 was 0.13 (SD=0.55) which was slightly lower than Wave 2 mean logged drug use (0.15, SD=0.46). The mean logged alcohol use for respondents at Wave 1 was 0.52 (SD=0.61) and for logged binge drinking was 0.29 (SD=0.53). Mean logged alcohol use for respondents at Wave 2 was 0.51 (SD=0.63) and for logged binge drinking was 0.32 (SD=0.56).

On average, 2% of one's peers reported having attended drug treatment in the past year (SD=12%). The average percent of one's peers who reported having used drugs during the past 30 days was 55 (SD=43%) and alcohol use during the past year was 50 (SD=43%).

Cross-sectional Analysis

Table 3 presents the results for the Wave 1 cross-sectional OLS regression models. These models provide a reference for the association between the proportion of one's peers who

reported drug treatment attendance and one's own levels of substance use. Model 1 presents the results of the analysis of Wave 1 illicit drug use, Model 2 the results of the analysis of Wave 1 alcohol use, and Model 3 the results of the analysis of Wave 1 binge drinking.

After statistically adjusting for peer drug use and the other variables in the model, the proportion of one's peers who reported attending drug treatment was positively associated with respondent drug use ($\beta = 0.2, p < 0.001$). Thus, as a larger share of one's friends attended drug treatment, respondent's tended to report higher levels of illicit substance use. This fails to support the hypothesis discussed earlier that posited a negative association.

Statistically adjusting for peer drug use and the other variables in the model, the proportion of one's peers who reported having attended drug treatment in the past year was not associated with the respondent alcohol use ($\beta = 0.09, p = 0.121$).

After statistically adjusting for the other variables in the model, the proportion of one's peers who reported drug treatment was associated with higher levels of respondent binge drinking ($\beta = 0.14, p < 0.01$). Consistent with the findings in model 1, as a larger proportion of one's nominated peers report attending drug treatment, respondents tended to report higher levels of binge drinking.

The associations between the three outcomes and the control variables were generally stable across the models. Furthermore, the level of statistical significance was also somewhat consistent across models. In particular, higher levels of SES were significantly associated with greater levels of alcohol use ($\beta = 0.02, p < 0.01$), but its association with the other outcome variables was not statistically significant.

Age and both drug and alcohol use were positively associated in all Wave 1 models (illicit drug use: $\beta = 0.01, p < 0.001$; alcohol use: $\beta = 0.06, p < 0.001$; binge drinking: $\beta = 0.05$,

$p < 0.001$). Males in the sample tended to consistently report higher levels of illicit drug use ($\beta = 0.06, p < 0.001$), alcohol use ($\beta = 0.06, p < 0.001$), and binge drinking ($\beta = 0.1, p < 0.001$) relative to females.

Compared to Whites in the sample, Blacks (illicit drug use: $\beta = -0.03, p < 0.01$; alcohol use: $\beta = -0.1, p < 0.001$; binge drinking: $\beta = -0.13, p < 0.001$) and Asian/Pacific Islanders (illicit drug use: $\beta = -0.04, p < 0.01$; alcohol use: $\beta = -0.14, p < 0.001$; binge drinking: $\beta = -0.11, p < 0.001$) tended to report significantly lower levels of drug and alcohol use. Native Americans tended to report significantly higher levels of illicit drug use ($\beta = 0.08, p < 0.001$) and alcohol use ($\beta = 0.06, p < 0.05$) than Whites, but reported similar levels of binge drinking ($\beta = 0.05, p = 0.05$). Those identifying as another race tended to report higher levels of drug and alcohol use relative to Whites. However, this association across all Wave 1 models was not statistically significant at the $p < 0.05$ level.

Parental attachment had a significant negative association with respondent drug and alcohol use across all Wave 1 models (illicit drug use: $\beta = -0.06, p < 0.001$; alcohol use: $\beta = -0.12, p < 0.001$; binge drinking: $\beta = -0.07, p < 0.001$). Conversely, respondents who reported having been to drug treatment tended to report significantly higher levels of substance use relative to those who did not report drug treatment (illicit drug use: $\beta = 0.17, p < 0.001$; alcohol use: $\beta = 0.3, p < 0.001$; binge drinking: $\beta = 0.33, p < 0.001$).

As expected, the proportion of one's peers who reported illicit drug use was positively associated with one's own drug use. Specifically, after statistically adjusting for the other variables in the model, the proportion of peers who use drugs was associated with higher levels of respondent drug use ($\beta = 0.18, p < 0.001$). Contrary to expectations, though, the proportion of one's peers who reported alcohol use was not associated with respondent illicit drug use at a

statistically significant level ($p=0.226$). The proportion of peers who use drugs was significantly associated with higher levels of respondent alcohol use ($\beta = 0.28, p<0.001$). Similarly, the proportion of peers who use alcohol was also significantly associated with higher levels of respondent alcohol use ($\beta = 0.11, p<0.01$). The proportion of peers who use drugs was associated with higher levels of respondent binge drinking behavior ($\beta = 0.22, p<0.001$). However, the proportion of one's peers who use alcohol was not associated with higher levels of respondent binge drinking ($p=0.13$).

[Table 3 about here]

Across Wave Analysis

Table 4 presents the results for the across-wave OLS regression models. These models capture changes in the levels of one's drug use over time. Model 4 presents the results of the analysis of Wave 2 illicit drug use, model 5 the results of the analysis of Wave 2 alcohol use, and model 6 the analysis of Wave 2 binge drinking.

After statistically adjusting for Wave 1 drug use, peer drug use, and the other variables in the model, the proportion of one's nominated peers who reported attending drug treatment did not have a statistically significant association with respondent illicit drug use at Wave 2 ($\beta = -0.04, p=0.427$).

Statistically adjusting for the effects of Wave 1 alcohol use, peer drug use, and the other variables in the model, the proportion of one's friends who attended drug treatment was not significantly associated with respondent alcohol use levels at Wave 2 ($\beta = -0.07, p=0.269$).

Statistically adjusting for the effects of Wave 1 binge drinking, peer drug use, and the other variables in the model, the proportion of one's nominated friends who reported attending drug treatment was not significantly associated with lower respondent binge drinking behaviors

at Wave 2 ($\beta = -0.04, p=0.509$). The results of all Wave 2 models fail to support the hypothesis that respondent substance use levels are lower as a greater proportion of one's peers attend drug treatment.

The associations and level of statistical significance between the three Wave 2 outcomes and control variables were generally stable across models. Respondent SES was not significantly associated with illicit drug use ($\beta < 0.01, p=0.81$), alcohol use ($\beta = 0.02, p=0.056$), or binge drinking ($\beta < 0.01, p=0.62$).

Age had a significant association with higher levels of alcohol use ($\beta = 0.02, p<0.001$) and binge drinking ($\beta = 0.02, p<0.001$), but not for illicit drug use ($\beta = -0.002, p=0.482$). Relative to females in the sample, males tended to report significantly higher levels of illicit drug use ($\beta = 0.04, p<0.001$), alcohol use ($\beta = 0.03, p<0.05$), and binge drinking ($\beta = 0.07, p<0.001$).

Consistent with the Wave 1 models, Blacks (illicit drug use: $\beta = -0.01, p=0.492$; alcohol use: $\beta = -0.09, p<0.001$; binge drinking: $\beta = -0.1, p<0.001$) and Asian/Pacific Islanders (illicit drug use: $\beta = -0.04, p<0.05$; alcohol use: $\beta = -0.08, p<0.01$; binge drinking: $\beta = -0.08, p<0.01$) tended to report significantly lower drug and alcohol use levels compared to Whites. Relative to Whites in the sample, Native Americans tended to report lower non-significant illicit drug use levels ($\beta = -0.01, p=0.762$) and significantly higher levels of alcohol use ($\beta = 0.06, p<0.05$) and binge drinking ($\beta = 0.06, p<0.05$). Contrary with the Wave 1 models, those identifying as another race tended to report lower levels of illicit drug use ($\beta = -0.02, p=0.34$), alcohol use ($\beta = -0.02, p=0.358$), and binge drinking ($\beta = -0.01, p=0.746$) relative to Whites in the sample at Wave 2. However, this relationship was not significant at the $p<0.05$ level. As expected, Wave 1 illicit drug use ($\beta = 0.49, p<0.001$), Wave 1 alcohol use ($\beta = 0.54, p<0.001$), and Wave 1 binge

drinking ($\beta = 0.51, p < 0.001$) were significantly associated with higher substance use levels at Wave 2.

Consistent with Wave 1 models, parental attachment was associated with significantly lower drug use levels for all Wave 2 models (illicit drug use: $\beta = -0.04, p < 0.001$; alcohol use: $\beta = -0.04, p < 0.01$; binge drinking: $\beta = -0.04, p < 0.01$). Adolescents in the sample who reported drug treatment tended to report higher levels of illicit drug use ($\beta = 0.04, p = 0.339$) and binge drinking ($\beta = 0.06, p = 0.216$), but lower levels of alcohol use ($\beta = -0.01, p = 0.867$) compared to those who did not report drug treatment attendance. However, these relationships were not significant at the $p < 0.05$ level.

Statistically adjusting for the effects of Wave 1 drug use and the other variables in the model, the proportion of one's peers who use drugs is associated with significantly higher levels of respondent drug use at Wave 2 ($\beta = 0.1, p < 0.01$). However, the proportion of peers who reported alcohol use did not have a statistically significant relationship with respondent illicit drug use ($\beta = -0.02, p = 0.602$). After statistically adjusting for Wave 1 alcohol use and the other variables in the model, the proportion of one's peers who use illicit drugs ($\beta = 0.04, p = 0.324$) and alcohol ($\beta = 0.08, p = 0.66$) did not have a statistically significant association with respondent alcohol use levels at Wave 2. After statistically adjusting for the effects for Wave 1 binge drinking and the other variables in the model, the proportion of peers who reported illicit drug use did not have a statistically significant relationship with respondent binge drinking at Wave 2 ($\beta = 0.06, p = 0.094$). However, the proportion of one's peers who reported alcohol use is significantly related with higher levels of respondent binge drinking at Wave 2 ($\beta = 0.08, p < 0.05$).

[Table 4 about here]

DISCUSSION

Adolescent drug use continues to be a societal concern (Gilvarry 2000; Strasburger 2010; Swendsen et al. 2012; Winters, Botzet, and Fahnhorst 2011) especially since participation in substance use and other delinquent or criminal behaviors are closely related (Bennett et al. 2008; Darke et al. 2010; Fergusson et al. 2002; Henry, Tolan, and Gorman-Smith 2010; Patterson, Dishion, and Yoerger 2000). Research is clear that adolescents whose peers use drugs are more likely to also use these substances themselves (Ali and Dwyer 2010; Reid et al. 2015). Although adolescent drug treatment has been observed to reduce use levels (Williams and Chang 2000) relapse rates are high with instances of relapse often occurring in social settings (Brown et al. 1989; Cornelius et al. 2003). Research on smoking cessation in adults suggests that abstinence may be influenced by one's peers (Christakis and Fowler 2008a, 2008b). Therefore, as one's peers' exhibit lower substance use levels following drug treatment, this may have an influence on individuals to maintain low levels of use themselves. Recent research on adolescent drug prevention interventions indicates that the benefits of an intervention may be passed to one's peers who did not themselves participate in the intervention (Rulison, Feinberg, et al. 2015; Rulison, Gest, et al. 2015). The purpose of this study was to determine if a similar effect is observed for substance abuse treatment attendance in that as one's peers realize lower use levels following drug treatment individuals also benefit from their peers' behaviors.

The results of this study using Wave 1 outcome measures of illicit drug use, alcohol use, and binge drinking behaviors fail to find any support of the diffusion of the effects of peer drug treatment to respondents who did not themselves attend drug treatment. In fact, in two of the three models—those examining illicit drug use and binge drinking—respondents who had a larger proportion of their peers who received substance use treatment were significantly more likely to

report higher levels of drug and alcohol use. Consistent with past findings, the other peer influence variables also tended to have a significant positive relationship with respondent drug use (Ali and Dwyer 2010; Havassy et al. 1991; Prinstein et al. 2001; Rosenquist et al. 2010). Furthermore, peers who received drug treatment may have relapsed shortly thereafter which may account for reductions in substance use levels not being passed on to respondents in this sample.

Looking at the effects of peer substance abuse treatment on one's drug use levels over an extended period also fails to support the hypothesis that the effects of drug treatment may diffuse to others. Although the coefficients for models 4-6 using Wave 2 outcome variables are in the hypothesized direction, each of them fails to reach statistical significance at the $p < 0.05$ level. Similar to the Wave 1 models, the Wave 2 models also fail to support the hypothesized relationship between the proportion of peers who attend substance use treatment and one's respondent drug use. The strongest peer influence in these models was again from peers who reported illicit drug and alcohol use.

Implications

A major implication from this research for those providing drug treatment to adolescents is the negative association between strong parental attachment and lower respondent substance use levels. Although not the focus of this research, there appear to be positive benefits of strong parental attachment when it comes to the risk of adolescent substance use. Adolescence is a time when individuals form new social groups and relationships with peers take a more important role in an adolescent's life. The results of this study suggest that when youth have higher levels of parental attachment, they tend to report significantly lower drug use levels than those with lower levels of parental attachment. Indeed, in all six models, higher levels of parental attachment were associated with significantly lower illicit drug and alcohol use levels for respondents. Therefore,

drug treatment programs that facilitate and strengthen the bonds that an adolescent has with his/her parents may prove to be especially effective. The results of several studies confirm that family therapies can reduce drug use levels among adolescents (Liddle et al. 2008; Ozechowski and Liddle 2000; Rowe 2012). It is possible then that this attachment may offset and overpower negative peer influence to participate in drug using behaviors. Clinicians may also seek to educate parents on this potential buffering effect that they can have against negative peer influence.

The results of this study indicate that adolescents in this sample were more susceptible to the effects of negative peer influence than they were to a potential form of positive peer influence. As discussed previously, having drug using peers in one's network is associated with one's own substance use behaviors (Ali and Dwyer 2010; Rosenquist et al. 2010). Furthermore, individuals tend to relapse following drug treatment due to social situations (Brown et al. 1989; Chung and Maisto 2006). Therefore, an implication of this research is that clinicians should spend time both addressing and emphasizing the importance of forming strong relationships with non-using peers who are supportive of abstinence.

Limitations

A major shortcoming of this research is the inability to determine what type of drug treatment individuals in the sample received. Although the Wave 1 survey does ask respondents to indicate where substance abuse treatment was received, the data do not allow researchers to differentiate between types of treatment. Research on drug treatment programs indicates that substance abuse programs are not equal in their effectiveness (Bahr, Masters, and Taylor 2012). In depth data on types of drug treatment programs coupled with peer nominations are needed to better understand this complex issue.

Another limitation of this study is that even though the data are nationally representative, the number of participants between the In-School survey and the In-Home Wave 1 survey decreases substantially. Therefore, although individuals nominated their peers during the In-School survey, many of their peers were not sampled at subsequent waves. This decreases the amount of information available on one's social network, making it difficult to accurately measure some of the characteristics of a respondent's social network. However, there is a lack of social network data that incorporates nominated peers' own self-reports making Add Health one of the premier data sets to study social networks and peer influence topics. More proper social network data on drug use and drug treatment is needed to fully understand how the effects of formal drug treatment diffuse to others and impact those in one's social network.

As previously discussed, ANOVA tests were used to compare respondents who made at least one applicable nomination, did not make any applicable nominations, and made no nominations. Although the analysis revealed little difference between these groups, there is no doubt that those respondents who did not make any applicable nominations are influenced by their peers. However, the data do not allow for this influence to be measured as there is not data linked to such individuals. Therefore, the direction or strength of the influence that these peers may have on those who nominated them cannot be measured. Similarly, those who failed to make applicable nominations are likewise influenced by the peers whom they nominated. ANOVA analysis revealed a significant difference between these individuals and those who made at least one applicable nomination with regard to Wave 1 illicit drug use. Because these individuals reported illicit drug use levels lower than those who made applicable nominations, it is likely that the peers of such individuals also use substances at lower levels (Ali and Dwyer 2010; Havassy et al. 1991). However, determining the prevalence of substance use treatment

attendance among these peers is not possible with the data. Questions remain about how such individuals are influenced by their peers as data on their social networks were not collected.

Additionally, a common issue among surveys that rely on self-reported data, is that of respondents providing inaccurate data. It is probable that some respondents in the sample reported levels of substance use inconsistent with their actual behavior. Although self-report measures are convenient for data collection, they are not without error and are prone to nonrandom reporting errors. A number of studies find that for both substance use and other behaviors, respondents' self-report answers are less than accurate (Dolcini et al. 2003; Elgar, Stewart, and Stewart 2008; Fan et al. 2006; Gorber et al. 2007; Shillington and Clapp 2000; Williams and Nowatzki 2005; Winters et al. 1990). Furthermore, Hoeppe and colleagues (2010) suggest that the further back respondents have to recall and report on their behavior, the less reliable the data are. Although inconsistent reporting of specific substances or by specific racial groups could influence the results of this study (Fendrich and Mackesy-Amity 1995; Fendrich and Vaughn 1994; Mensch and Kandel 1988; Percy et al. 2005), the direction of influence of nonrandom over or underreporting of substance use cannot be determined.

CONCLUSION

This study sought to investigate a positive form of peer influence which is often overlooked in criminological literature. The results from this study fail to find support for the hypothesis that the greater the proportion of one's peers who attend drug treatment, the lower respondent substance use levels will be. Consistent with past literature, negative peer influence in this study—measured by the proportion of one's peers who report illicit drug and alcohol use—was associated with higher levels of respondent drug and alcohol use levels. Peer drug and alcohol use had a greater influence on respondent drug use levels than did peer drug treatment.

Thus, in this sample, the effects of drug treatment appear to not diffuse to the other members of one's network thereby lowering the substance use levels of those who did not themselves attend drug treatment.

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TABLES

Table 1. Descriptive Statistics for Respondents in the Sample Who Made at Least One Applicable Peer Nomination and Have Information on their Peers

Variable	Mean/Percent	S.D.
Sex		
Male	54.29	
Female	45.71	
Race/Ethnicity*		
White	58.08	
Black or African American	21.99	
Asian or Pacific Islander	9.26	
American Indian	5.61	
Other Race	9.25	
Nomination Type		
No Nominations	13.69	
Invalid Nominations	9.86	
Valid Nominations	79.45	
Respondent Drug Treatment	2.11	
Wave 1 No Alcohol Use	53	
Wave 1 No Binge Drinking	74.8	
Wave 2 No Alcohol Use	55.6	
Wave 2 No Binge Drinking	73	
Age	14.98	1.7
SES (Standardized)	0.02	0.8

Parental Attachment (Range 1-5)	4.63	0.55
Wave 1 Illicit Drug Use (logged)	0.13	0.46
Wave 1 Alcohol Use (logged)	0.52	0.61
Wave 1 Binge Drinking (logged)	0.29	0.53
Wave 2 Illicit Drug Use (logged)	0.15	0.46
Wave 2 Alcohol Use (logged)	0.51	0.63
Wave 2 Binge Drinking (logged)	0.32	0.56
Peer Proportion Network Characteristics		
Illicit Drug use	0.55	0.43
Alcohol Use	0.5	0.43
Drug Treatment	0.21	0.12

Source: National Longitudinal Study of Adolescent to Adult Health (1994-96).

N=9,032

S.D.= Standard Deviation

*Percentages may not add up to 100 due to rounding

Table 2. Analysis of Variance (ANOVA) Between Respondents Who Made at Least One Applicable, No Applicable, and no Peer Nominations and Key Analytic Variables

SES			Parental Attachment		
	Mean	S.D.		Mean	S.D.
No Nominations	-0.12 ^a	0.80	No Nominations	4.60 ^a	0.62
Invalid Nominations	-0.13 ^b	0.78	Invalid Nominations	4.56 ^b	0.64
Valid Nominations	0.02	0.80	Valid Nominations	4.63	0.55
F-value	28.75		F-value	8.68	
p-value	<0.05		p-value	<0.05	
Wave 1 Illicit Drug Use (logged)			Wave 1 Alcohol Use (logged)		
	Mean	S.D.		Mean	S.D.
No Nominations	0.19 ^a	0.57	No Nominations	0.47 ^a	0.63
Invalid Nominations	0.02 ^b	0.57	Invalid Nominations	0.52	0.62
Valid Nominations	0.13	0.46	Valid Nominations	0.52	0.61
F-value	15.2		F-value	5.14	
p-value	<0.05		p-value	<0.05	
Wave 1 Binge Drinking (logged)			Wave 2 Illicit Drug Use (logged)		
	Mean	S.D.		Mean	S.D.
No Nominations	0.30	0.57	No Nominations	0.16	0.50
Invalid Nominations	0.30	0.55	Invalid Nominations	0.18	0.53
Valid Nominations	0.29	0.53	Valid Nominations	0.15	0.46
F-value	0.82		F-value	1.49	
p-value	0.44		p-value	0.23	

Wave 2 Alcohol Use (logged)			Wave 2 Binge Drinking (logged)		
	Mean	S.D.		Mean	S.D.
No Nominations	0.43 ^a	0.06	No Nominations	0.29	0.56
Invalid Nominations	0.49	0.63	Invalid Nominations	0.35	0.59
Valid Nominations	0.51	0.63	Valid Nominations	0.56	0.56
F-value	8.96		F-value	2.03	
p-value	<0.05		p-value	0.13	

Note: Respondents in the Valid Nominations category were those who made at least one valid peer nomination during the In-School survey.

^a Difference between Valid and No Nominations is statistically significant at $p < 0.05$ level

^b Difference between Valid and Invalid Nominations is statistically significant at $p < 0.05$ level

Source: National Longitudinal Study of Adolescent to Adult Health (1994-96).

Table 3. OLS Regression Results for Wave 1 Logged Outcome Variables Regressed on Network Characteristics and Control Variables (Standard Errors in Parentheses)

	Model 1: Illicit Drug Use	Model 2: Alcohol Use	Model 3: Binge Drinking
Peer Drug Treatment	0.2*** (0.04)	0.09 (0.06)	0.14** (0.05)
Peer Illicit Drug Use	0.18*** (0.03)	0.28*** (0.04)	0.22*** (0.03)
Peer Alcohol Use	-0.37 (0.03)	0.01** (0.04)	0.05 (0.04)
Respondent Drug Treatment	0.17*** (0.04)	0.3*** (0.05)	0.33*** (0.04)
SES	0.00 (0.01)	0.02** (0.01)	0.00 (0.01)
Parental Attachment	-0.06*** (0.01)	-0.12*** (0.01)	-0.07*** (0.01)
Age (in years)	0.01*** (0.)	0.06*** (0.)	0.05*** (0.)
Male	0.06*** (0.01)	0.06*** (0.01)	0.1*** (0.01)
Black or African American	-0.03** (0.01)	-0.1*** (0.16)	-0.13*** (0.14)
Asian or Pacific Islander	-0.04** (0.02)	-0.14*** (0.03)	-0.11*** (0.02)
American Indian or Native American	0.08*** (0.02)	0.06* (0.03)	0.05 (0.02)
Other Race	0.02 (0.02)	0.02 (0.02)	0.00 (0.02)
Constant	0.11 (0.07)	-0.07 (0.08)	-0.29 (0.08)

R ²	0.05	0.17	0.14
Adjusted R ²	0.05	0.16	0.14
N	7,630	7,653	7,652

Source: National Longitudinal Study of Adolescent to Adult Health in Home Wave 1 (1994-95).

*p-value <0.05 **p-value <0.01 ***p-value <0.001

Table 4. OLS Regression Results for Wave 2 Logged Outcome Variables Regressed on Network Characteristics, Control Variables, and Logged Wave 1 Respondent Drug Use Variables (Standard Errors in Parentheses)

	Model 4: Illicit Drug Use	Model 5: Alcohol Use	Model 6: Binge Drinking
Peer Drug Treatment	-0.04 (0.05)	-0.07 (0.06)	-0.04 (0.06)
Peer Illicit Drug Use	0.1** (0.03)	0.04 (0.04)	0.06 (0.04)
Peer Alcohol Use	-0.02 (0.03)	0.08 (0.04)	0.08* (0.04)
Respondent Drug Treatment	0.04 (0.04)	-0.01 (0.05)	0.06 (0.05)
SES	0.00 (0.01)	0.02 (0.01)	0.00 (0.01)
Parental Attachment	-0.04*** (0.01)	-0.04** (0.01)	-0.04** (0.01)
Age (in years)	<-0.01 (0.)	0.02*** (0.)	0.02*** (0.)
Male	0.04*** (0.01)	0.03* (0.01)	0.07*** (0.01)
Black or African American	-0.01 (0.01)	-0.09*** (0.02)	-0.1*** (0.02)
Asian or Pacific Islander	-0.04* (0.02)	-0.08** (0.03)	-0.08** (0.02)
American Indian or Native American	-0.01 (0.02)	0.06* (0.03)	0.06* (0.03)
Other Race	-0.02 (0.02)	-0.02 (0.02)	-0.01 (0.02)

Wave 1 Respondent Drug Use (logged)	0.49*** (0.01)	—	—
Wave 1 Respondent Alcohol Use (logged)	—	0.54*** (0.01)	—
Wave 1 Respondent Binge Drinking (logged)	—	—	0.51*** (0.01)
Constant	0.25** (0.72)	0.06 (0.09)	0.02 (0.09)
R ²	0.25	0.34	0.30
Adjusted R ²	0.25	0.33	0.30
N	5,702	5,704	5,703

Source: National Longitudinal Study of Adolescent to Adult Health in Home Waves 1 and 2 (1994-96).

*p-value <0.05 **p-value <0.01 ***p-value <0.001

FIGURES

Figure 1. Illustrates the Calculation of the Proportion of One's Peers Who Reported Attending Drug Treatment in the Past Year

Friend 1	Friend 2	Friend 3	Friend 4	Friend 5	Proportion
no	no	no	yes	yes	0.4

The proportion of nominated friends who report drug treatment attendance for this respondent is 0.4
Source: Author

Figure 2. Illustrates the Calculation of the Proportion of One's Peers Who Reported Using Drugs

Friend 1	Friend 2	Friend 3	Friend 4	Friend 5	Proportion
yes	no	no	yes	yes	0.6

The proportion of nominated friends who report drug use for this respondent is 0.6

Source: Author