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Peer Standing and Substance Use in Early-Adolescent Grade-Level Networks: A Short-Term Longitudinal Study

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Abstract

Two competing hypotheses were tested concerning the associations between current alcohol and cigarette use and measures of individual, group and network peer standing in an ethnically-diverse sample of 156 male and female adolescents sampled at two time points in the seventh grade. Findings lent greater support to the person hypothesis, with early regular substance users enjoying elevated standing amongst their peers and maintaining this standing regardless of their maintenance of or desistance from current use later in the school year. In the fall semester, *users* ($n=20$, 13%) had greater social impact, were described by their peers as more popular, and were more central to the peer network than *abstainers* (i.e., those who did not report current use).

Conversely, in the spring semester, there were no differences between users ($n=22$, 13%) and abstainers in peer ratings of popularity or social impact. Notably, the spring semester users group retained fewer than half of the users from the fall semester. Further, students who had reported current use in the fall, as a group, retained their positions of elevated peer standing in the spring, compared to all other students, and continued to be rated by their peers as more popular and as having greater social impact.

We discuss the findings in terms of the benefit of employing simultaneous systemic and individual measures of peer standing or group prominence, which in the case of peer-based prevention programs, can help clarify the truly influential from the “pretenders” in the case of diffusion of risk-related behaviors.

Keywords

Early adolescents; Substance use; Peer standing; Social networks

The social dynamics of influence in peer networks have been well documented in the social psychological research literature, yet very little of this basic research has been applied in drug prevention programming. Studies that have taken this approach have demonstrated that social influences are the primary factor in the adolescent initiation of drug using and abusing behaviors (Donaldson et al., 1996; Flom, Friedman, Jose, & Curtis, 2001; Harrison, Fulkerson,

& Park, 2000; Olds & Thombs, 2001). For adolescents, peer influence supplants adult influence as a prime factor in shaping behavioral norms, beliefs, and a wide range of both positive and negative behaviors, including substance use (Dishion & Medici Skaggs, 2000; Ennett & Baumann, 1994; Kandel, 1978; Thornberry & Krohn, 1997; Urberg, Degirmencioglu & Pilgrim, 1997).

In recognition of the power of influential peers, guidelines for substance use prevention programs in schools recommend the use of peer leaders (Journal of School Health, 1994), and many such active peer-led programs are successful at reducing substance use in the schools (Black, Tobler, & Sciacca, 1998). However, peer influence is not equally distributed across the peer network. Rather, there is a hierarchy of influence power in peer social groups, with some individuals being more potent than others, and consequently with greater power to transmit information about norms and behaviors. In the present investigation, our goal was to examine the relationship between relative peer standing in school-based peer groups and substance use (tobacco smoking and alcohol use) among early adolescents, and to determine whether such relations derived from the power of the person using substances or the substance-using behavior per se. We employed a multi-method approach to the measurement of peer standing, using several measures derived from self-reports, peer reports, and network analyses.

Identifying powerful and influential youth in peer networks remains an important task. One way to approach this question is to consider “peer standing,” or where an individual stands in relation to his or her peers. Three of the main approaches to the measurement of peer standing among early adolescents are peer ratings along various dimensions, such as perceived popularity; sociometrically-derived peer social statuses; and social network measures, such as network centrality. Popularity as a peer-rated status is defined in different ways. In traditional sociometric analyses, popularity is an index of social desirability, derived from a consensus of peers who report liking the target child (Newcomb, Bukowski, & Pattee, 1993) and resulting either in the assignment of children to one of five sociometric categories, including *popular* (Coie, Dodge, & Coppotelli, 1982), or in assigning a continuous score of *social preference*, derived from subtracting “like least” nominations from “like most” (Coie et al., 1982). More recently, researchers have applied quantitative approaches to the measurement of peer *perceived popularity*, or reputation-based popularity, derived from a simple count of the number of peers who rate the target child as “popular” (LaFontana & Cillessen, 1999; Parkhurst & Hopmeyer, 1998).

In social network analysis, popularity has been defined as the number of friendship nominations (standardized within class) a child receives (e.g., Valente, Unger, & Johnson, 2005). In the social network paradigm, high social status is reflected in an index of social centrality, which is perhaps understood to align more closely with the sociometric controversial status. These distinctive estimates of popularity (i.e., sociometric standing versus perceived popularity) have yielded divergent associations with prosocial and antisocial behaviors (Parkhurst & Hopmeyer, 1998) and with behavioral correlates and self-esteem (de Bruyn & van den Boom, 2005).

Both positively connoted (i.e., “liking”) and negatively connoted (i.e., “disliking”) peer nominations or ratings have been shown to be *positively* associated with early adolescent substance use or increased risk for such use. For example, among children in grades 6 through 8, those who receive relatively high numbers of “friend” or “liking” nominations, including popular children (higher numbers of “friend” nominations; Valente et al., 2005) and controversial sociometric status youth (vs. average status; Aloise-Young & Kaepfner, 2005) are more likely to be smokers. Conversely, in other studies, children who receive relatively more “disliked” or “like least” nominations (i.e., those in rejected and isolated statuses), are reported as either current substance users or to be at increased risk for later use compared to average status youth (Dishion, Capaldi, Spracklen, & Li, 1995; Dishion, Capaldi, Yoerger,

1999). Likewise, youth isolated from or rejected by the wider network (i.e., those who received relatively few “friend” nominations) are more likely to smoke than are youth who occupy central or secondary positions in the network (Ennett & Baumann, 1994; Tani et al., 2001).

Positive ratings or nominations have also been shown to be *negatively* related to substance use. For example, popular status youth are less likely than average status students to smoke (Aloise-Young & Kaeppler, 2005). Finally, Ennett and colleagues (2006) report that adolescents who are “liked but not too well-liked”—a classification perhaps most closely consistent with “average” sociometric status—are least likely to be smokers. The relative status of adolescent friends also impacts the extent to which adoption of drinking behavior occurs over time: young adolescents are more likely to adopt the drinking behavior of a unilateral friend with higher status (Bot et al., 2001), and are more susceptible to influence from well-liked others (Latane, 1981), affirming the power of elevated peer standing to influence substance use behaviors.

Peer standing also has been addressed using indicators derived from social network analysis, with an increasing number of studies that assess both peer standing and substance use among adolescents using this framework (e.g., Alexander et al., 2001; Ennett & Baumann, 1993; Ennett et al., 2006; Pearson & West, 2003; Rodkin et al., 2000; Valente et al., 2005). According to social network theory (Knoke & Kulinski, 1982; Wasserman & Faust, 1994), individuals central to a bounded network (such as a classroom or grade) are both relatively visible and well-connected to others in the network, whereas less central or marginal (peripheral) members of the network are relatively less visible and less well-connected. Empirical findings indicate that when adolescents are central to their networks, they occupy roles from which they can exert leadership and influence their peers in both positive and negative ways (Cairns & Cairns, 1994; Rodkin et al., 2000). Accordingly, social network centrality uniquely predicts not only prosocial but also antisocial behaviors (Gest et al., 2001; Rodkin et al., 2000). Adolescents central to their networks may be seen as similar to those socially dominant children identified in the sociological tradition, who exert control over the flow of resources within the peer group (Hawley, 1999). In contrast, Granovetter (1973) has suggested that while central (and therefore prominent) network members are important in the adoption of non-controversial behaviors, it is the peripheral network members that are more likely to adopt controversial behaviors such as substance use.

Given the range of measures used in past research to operationalize peer standing and the differential relations between such measures and substance use, we sought to take a multimethod approach that would allow for some aggregation of both source (i.e., individual, peer) and basis (i.e., liking, visibility) of rating by simultaneously employing a diverse set of individual, group and network level indicators of peer standing derived from self-reports, peer nominations, and social network methods.

What remains unclear is whether peer influence over substance use is a function of the person or the behavior. Does engaging in rule-breaking behavior, such as using drugs at this early age, make one popular, central and visible? Or do popular, more central and visible youth use drugs early (and also or later engage in other rule-breaking or norm-violating behaviors)? If peer influence derives from attributes of the person, such as popularity or centrality within the peer network, then others in the peer network may be more likely to take up on a more regular basis behaviors apparently validated by such persons, perhaps in an effort to increase their own peer standing in the group. Alternatively, if peer influence is derived from specific counter-normative appeal of substance use behavior per se, then the relative peer standing of users should be rather unimportant.

From the foregoing, we derived competing hypotheses about the relative peer standing and position of substance users in the peer network and how this standing and position might change over time.

1. The *behavior hypothesis* holds that regular use of alcohol and cigarettes—relatively rare yet highly visible rule-breaking behavior among early adolescents—confers elevated peer standing on individuals. These behaviors in and of themselves embody the kind of sensation seeking propensity of high appeal in young adolescent peer groups. Youth who use are likely to enjoy such elevated standing, regardless of time of year, with newly-identified current users enjoying levels of peer standing equal to those who reported current use earlier in the year. Support for this hypothesis would be provided if current substance users are those who hold positions of elevated peer standing throughout the school year, regardless of whether the membership of this group changes over the course of the year. Thus,

Hyp. 1A. At the beginning of the school year (Fall, Time 1), current substance users will exhibit elevated peer standing, including relatively high social impact, perceived popularity, and network centrality, compared to non-users in the peer network.

Hyp. 1B. Towards the end of the school year (Spring, Time 2), a similar pattern of relatively elevated peer standing indicators will emerge for current users versus their non-using counterparts.

2. Conversely, the *person hypothesis* can be stated thus: Central, popular, more highly visible youth are more likely to evidence novel rule- or norm-breaking behaviors, including regular early substance use. One might conjecture that it is their “leadership” in counter-normative behavior that helps render them visible in their peer environment. Such youth are likely to maintain their elevated peer standing regardless of whether they maintain or desist from regular substance use later in the school year. Indeed, they may initiate higher levels of other rule- or norm-breaking behaviors compared to their peers. Support for this hypothesis would emerge if current users identified at the outset of the 7th grade year were rated by their peers as more popular, central and visible in the network (ie., *Hypothesis 1A*, above). Further support for this hypothesis would be evident if such individuals retain their elevated peer standing later in the school year, regardless of whether they continued to report current substance use. Also, those who become regular users late in the year may not enjoy relatively elevated peer standing: they may be youth who began the school year with relatively less cache and for whom, the less visible or distinctive rule-breaking behavior does not bring with it elevated peer standing. That is, as the behavior becomes more normative, it loses its cache in the network. Thus,

Hyp. 2A. At Time 2, students reporting current substance use will not differ from non-using participants on measures of peer standing.

Hyp. 2B. Substance users identified at Time 1 will maintain their elevated peer standing in the Spring (Time 2), regardless of their reported current substance use in the Spring. That is, fall users will exhibit elevated peer standing, including relatively high social impact, perceived popularity, and network centrality, compared to all other students in the peer network, regardless of their current use status in the spring semester.

To address our hypotheses, we measured both sets of variables of interest—peer standing indicators and substance use measures—at two time points in the 7th grade year. Seventh grade (ages 12–13) is an extremely important year for the escalation of substance use: prevalence estimates of past 30 days alcohol and cigarette use both more than double from age 12 to age

13 (Substance Abuse and Mental Health Services Administration, 2005). Thus, at the beginning of grade 7, regular use is both a new, and more importantly, a relatively *distinctive* behavior among children of this age. By the end of the seventh grade however, substance use is a relatively more common and less distinctive behavior.

Method

Participants

Participants were drawn from an urban magnet school of approximately 1400 students in grades 6 through 12 in north central North Carolina. Approximately 21% of students in the school receive free or reduced school lunch, compared to 45% district-wide. In the fall 2004 semester, the entire seventh grade ($N=203$) was invited to participate in a study of peer social influences on substance use and other risk-taking behaviors. Parent consent and student assent were obtained for 83% of the grade 7 students, for a total of 168 (51% female; 42% European American; 41% African American; 5% Latino, 10% multi-ethnic, and 2% other; mean age at Time 1=12.21, $SD=0.51$, range 12–14). Approximately 6 months later, all students in 7th grade ($N=208$) were again invited to participate in a planned follow-up study. Students who had completed the study materials at the first round of data collection, and who consented to participate and provided valid responses to the main study variables at both time-points, were retained, resulting in an analytic sample of 156 students, the composition of which mirrored very closely the gender and racial/ethnic make-up of the school (sample: 49% male; 42% European American; 46% African American; 7% Latino, 3% multi-ethnic, and 2% other; mean age at Time 2=12.77, $SD=0.56$, range 12–15).

Procedure and measures

Project staff administered a survey to consented students during a 100-minute class period. Students received a small incentive (five dollars in cash) for completing the survey. Several peer nomination methods were used to derive individual-, group-, and social network-level measures of peer standing, and self-report items were used to determine prevalence of alcohol and tobacco use.

Self-report survey—The survey included measures of student demographics and self-reports of past month and lifetime use of alcohol and tobacco. Current drinking (smoking) was measured with the item, “On how many days in the last month did you have an alcoholic drink (smoke a cigarette)?” Students reporting one or more days’ use were identified as current drinkers (smokers). Lifetime alcohol use (tobacco use) was measured with the item, “Have you ever had a drink of alcohol (smoked a cigarette)?” Recent studies suggest that self-report of substance use among adolescents is a reliable, if imperfect, indicator of use (O’Malley, Johnston, Bachman, & Schulenberg, 2000; Wallace & Bachman, 1997), and single item measures have demonstrated reliability and predictive power similar to other more complex measures such as Timeline Followback and frequency—quantity indexes (LaBrie, Pedersen, & Earleywine, 2005).

Social cognitive map—Participants were asked about social networks within their grade at their school, beginning with the question: “Are there some kids here in seventh grade who hang around together a lot?” Participants were then instructed to write the names of the children who hang around together (i.e., nominations) using a free recall procedure to identify all real-world groups of seventh graders in their school. The computer program SCM version 4.0 was used to combine information across all subjects and determine groups within the social network based on the Social Cognitive Map procedure developed by Robert Cairns and his colleagues (1989).

Measures derived from the SCM analysis included indexes of individual, group and network centrality, and assignment of respondents to categorical levels of individual and group centrality, as follows: *Individual centrality* was derived from the ratio of total number of nominations received to the average number of nominations received by the top two members of the group. *Group centrality* was derived from the ratio of the average number of nominations received by the top two members of the group to the average of the top two groups. *Social network centrality* was indexed by the lower of the individual and group centrality scores. Both individual and group centrality scores were recoded into *nuclear* (0.7 to 3.0), *secondary* (0.3 to 0.6999), and *peripheral* (0 to 0.2999). Nuclear centrality describes students who are nominated at a high frequency, secondary centrality describes students nominated at an average frequency, and peripheral centrality describes students nominated at a low frequency (Farmer & Rodkin, 1996).

Sociometrics—Participants were provided with a roster of all the seventh grade students in their school and were asked to make unlimited nominations of peers who fit into various behavioral and social influence descriptors. To assess social status, students were instructed to name students they “liked the most” (LM) and “liked the least” (LL). The other peer nomination item used in the present study was “Are the most popular in the seventh grade” (i.e., perceived popularity). A computer program (Sociometric Collection and Analysis [SCAN] version 5.0.5; DeRosier & Thomas, 2003) was used to analyze the nominations. Using procedures outlined by Coie and colleagues (1982), individual standardized scores were derived for *social impact* (LM+LL), *social preference* (LM–LL), and *perceived popularity*. Social impact indexes the degree to which individuals are visible in the social environment. Social preference indexes likability (i.e., sociometric popularity, Coie et al., 1982), and perceived popularity (Parkhurst & Hopmeyer, 1998) is an index of the degree to which others rate the targets as popular individuals. The perceived popularity measure is both theoretically and empirically distinct from liking, or sociometric popularity, in that it indexes the degree to which adolescents are explicitly identified as “popular” members of the network, tapping both reputation and impact in the social environment (Cillessen & Rose, 2005).

Social network measures—Mutual “liking” nominations derived from the sociometric nomination procedure described above were submitted separately by semester to the NEATO (North, 2002) Graphviz computer program (available at www.graphviz.com). Sociograms, or graphs, of the networks were produced from these mutual liking nominations based on the patterns of associations between persons (nodes). Network graphs depicting the samples in fall and spring are shown in Figs. 1 and 2, respectively. The location of each node is determined by its direct and indirect (connected through another person) ties or connections to other nodes (i.e., persons in the network). These ties between persons, termed “edges,” are represented by the lines connecting the nodes. The location of each node is determined such that the geometric distance between every pair of nodes approximates the distance of the shortest path between nodes in the sociogram (North, 2002). We derived two measures to index the relative position and potential for influence of users within the networks in the fall and spring, betweenness centrality and Bonacich centrality, and three measures that describe the overall structure and organization of the networks, network density, mean distance, and the clustering coefficient.

Betweenness centrality, the simplest and most widely used measure of the centrality of network members (Freeman, 1979), is defined as “the number of times that a node needs a given node to reach another node... [That is, it] is the number of shortest paths (between all pairs of nodes) that pass through a given node” (Borgatti, 1995). The idea is that the central actors (i.e., nodes) who lie on the paths between many others have more power to control behavior or information that diffuses along the paths in the network. Actors who are higher in betweenness, then, can be said to hold greater power in the network, with the concomitant likelihood of holding and exerting greater influence within the network.

Bonacich (1987) proposed an alternative centrality measure that is based on the connectivity of persons: central persons must be the most active in the sense that they have many connections to other persons. The *Bonacich centrality* of an actor is recursively related to the sum of centralities of the actors with whom he or she is connected. Hence, a person that is connected to many persons who are themselves well-connected is assigned a high degree of centrality, whereas a person who is connected only to near isolates is not.

Network density is indexed by the proportion of all ties that *could* be present in the network that actually *are* present (Hanneman, n.d.). The *mean distance* of a network measures the average number of steps that is required to connect any two persons in the network. Formally, it is defined by the mean geodesic distance between any possible pairs of nodes (Newman, 2003). Finally, the *clustering coefficient* of a network is defined by the fraction of the number of links between nodes within its neighborhood divided by the number of possible links between those nodes. Larger clustering coefficient values can be interpreted to index the fact that a friend of your friend is more likely to be your friend (Newman, 2003).

Results

We first report the prevalence of alcohol use and cigarette smoking in the sample at each time point. We then examine the correlations, means and standard deviations for the study variables to determine the support for our hypotheses. Finally, we present a brief description of the wider peer networks at each time point, to provide a broader context for the individual- and peer-level findings.

Substance use prevalence

Alcohol and cigarette smoking are not very prevalent in the early adolescent group studied here. Lifetime tobacco use (14% and 18%, fall and spring semesters, respectively) was much lower than lifetime alcohol use (38% and 46%), which showed a significant increase over the school year, $t(149)=2.147, p<.05$. Relatively few students reported current use of cigarettes (4% and 6%) or alcohol (10% and 13%) at each time point, and neither of these behaviors showed any significant increase over time. Moreover, approximately two-thirds of the students who *did* report current use at each time point reported drinking alcohol or smoking on only 1–2 days in the past month. The prevalence rates of alcohol and cigarette use in our sample are substantially lower than those in the 2004 MTF data for 8th graders, as would be expected for our respondents who were surveyed a full grade earlier (Johnston, O'Malley, Bachman, & Schulenberg, 2005), except in the case of lifetime alcohol use: for 8th graders in the 2004 MTF sample, the rate is 44%, very similar to the rate of 46% for our 7th graders in the spring semester.

Due to the relatively small numbers of substance users in this sample, we constructed groups of *users*, those who were *either* current drinkers *or* current smokers, for each semester. Importantly, although equal proportions (13%) of youth in the fall and the spring report current use, there is substantial turnover in those adolescents comprising the users groups: almost half (9 of 20) of the adolescents who are current drinkers and/or smokers in the fall do not report such current use in the spring, and this finding restricted our ability to follow those who reported current use in both fall and spring.

Tests of the hypotheses

We next turned our attention to testing our hypotheses. First, the behavior hypothesis, which holds that regular substance use confers elevated peer standing on young adolescents. There are two related parts to this hypothesis, as follows:

Hyp. 1A. Current substance users will exhibit elevated peer standing—Several results provide some support for this hypothesis: As shown in Table 1, in the fall semester, users were rated by their peers as being more popular (i.e., perceived popularity), $t(154)=|2.71|$, $p < .01$ and as having greater social impact, $t(154)=|4.49|$, $p < .001$, than their abstaining peers. Moreover, being a user was significantly, moderately correlated with both popularity and social impact (see Table 2). In contravention to this hypothesis, however, users and abstainers, considered at the level of the individual, are similarly distributed in terms of occupancy of more or less central roles within the network, with approximately equal proportions occupying nuclear, secondary and peripheral roles (see Table 1). This finding is buttressed by the lack of significant bivariate relations between use and measures of centrality. In contrast to the centrality measures derived from the SCM analyses, on the network measures of centrality—betweenness and bonacich centrality—users in the fall were more central than were abstainers, $t(154)=|2.55|$, $p < .05$ and $t(154)=|2.66|$, $p < .01$, respectively.

Hyp.1B. In the spring semester, a similar pattern of relatively elevated peer standing indicators will emerge for current users versus their non-using counterparts—In direct contravention to the behavior hypothesis, we found that current users no longer enjoyed elevated peer standing relative to their abstaining peers (see Table 1). Indeed, users and abstainers did not differ on social preference, social impact or popularity, and bivariate relations between use and these peer standing measures were minimal and non-significant. However, as shown in Table 3, use in the spring semester was inversely related to both individual and network centrality, suggesting that current users in the spring were more likely to occupy less central roles in the network than were abstainers.

Distribution of users and abstainers across individual network roles (Table 1) shows that, in contrast to the finding of no differences in the fall, in the spring, they were indeed differentially distributed ($\chi^2 = 11.706$, $df=2$, $p < .01$), with a clear move of users out of nuclear roles in the fall and into more secondary roles in the spring, whereas abstainers were more likely to maintain their roles across time. The marked change in the interrelationships among the three centrality measures from fall to spring supports the notion that there are substantial changes in the organization or structure of the grade 7 networks over the school year.

Taken together, these results suggest that users in the fall and those in the spring are not viewed similarly by their peers, nor do they occupy similar roles in the grade 7 network. Our results in the fall provide some support for the behavior hypothesis, but the dissimilar results from the spring suggest that we examine the person hypothesis more closely.

The *person hypothesis* holds that it is not the substance-using behavior per se that confers elevated peer standing but rather, that those persons who are more central, popular, and highly visible are more likely to engage in new norm-breaking behaviors, including regular early substance use, and that they maintain their standing regardless of their substance use throughout the year. Results reported above (Hyp. 1A) offer initial support for this hypothesis, as we noted that use in the fall was associated with elevated peer standing (Table 2). We next examine the second part of the person hypothesis.

Hyp. 2A. Students reporting current substance use in the spring will not differ from non-using participants on measures of peer standing—Use in the spring was not associated with measures of peer standing (see Table 3). Further, the network roles of users in the spring appeared to become less central compared to the abstainers. Recall that there was a good deal of turnover in the membership of the users and abstainers groups from fall to spring, with only 9 of the 20 fall users again reporting current use in the spring.

Hyp. 2B. Substance users identified at Time 1 will maintain their elevated peer standing in the Spring (Time 2), regardless of their reported current substance use in the Spring—We compared the *fall users group* to all other students on dimensions of peer standing measured in the *spring* semester. The fall users retained their elevated relative standing in the spring on both social impact, z scores = .609 vs. $-.124$, $t(154)=|3.13|$, $p < .01$, and perceived popularity, z scores = .324 vs $-.072$, $t(154)=|3.25|$, $p < .01$, suggesting that these students maintained the elevated peer standing they enjoyed at the beginning of 7th grade. Lending support to this finding is the high degree of stability among the peer standing measures from fall to spring. For example, social preference ($r=0.78$), social impact (0.71) and perceived popularity (0.88) were all very stable across the year (all $ps < .001$). The maintenance of relatively high levels of peer standing amongst the group of early regular users was evident even as more than half (11 of 20) reported no current use (i.e., past 30 days) of alcohol or cigarettes at the spring survey. Moreover, there was a good deal of instability in the reports of current use of both alcohol (fall—spring $r=0.19$, $p < .05$) and cigarettes ($r=0.38$, $p < .01$) over the course of the school year.

Peer social networks

Finally, we provide a description of the overall networks in fall and spring using several measures, shown beneath each figure (see Fig. 1 and Fig. 2). Although a direct statistical comparison of these measures across networks is not possible, we can make some plausible assertions based on them: First, the spring network is somewhat denser than the fall network. However, if the isolates are included in the network analysis, the spring network is relatively less dense and contains more isolates (20% vs. 10%). We can interpret these findings to say that the *overall* network becomes sparser in the spring but the *connected* network becomes denser. Second, the mean distance is smaller in the spring, implying that students can reach other students through a shorter connective path. Third, the clustering coefficient is larger in the spring, suggesting that groups of persons are more locally clustering together than in the fall. These network level findings offer support for our contention above that there are substantial changes in the structure and organization of the grade-level networks from fall to spring.

Discussion

In this study, we examined two hypotheses concerning the relationship between relative peer standing in adolescent grade-level networks and early, current substance use. Our findings provide stronger support for the *person* hypothesis. First, adolescents who reported current use of alcohol or cigarettes enjoyed elevated standing amongst their peers in the fall semester; second, when we compared the users from the fall semester to all other students in the spring, we found that these fall users did not lose their elevated position amongst their peers, even though fully half of them no longer reported current use in the spring. Finally, when we look at the spring data, we find that the distinct relation between use and social embeddedness in peer networks disappears: current users in the spring are *less* likely to occupy central roles both in their groups and in the network overall, compared to abstainers. These spring users are no more central or popular than are abstainers. These findings suggest that popularity and peer standing in this age group are neither driven by nor maintained solely by early substance use, and lead us to believe that there's something about the *timing* of regular use that's quite important in this particular age group.

Although others have concluded, quite reasonably, that early users have greater cache and centrality in young adolescent peer networks (Allen et al., 2005; Engels et al., 2005; Valente et al., 2005), we find that that current use per se does not confer power on young adolescents. Rather, such use appears to be an instance of norm-breaking behavior exhibited by those

adolescents who for some other (unmeasured) reason are already distinctive in their social environment. The early current users in the present study were somewhat older than their peers at the outset of 7th grade but age alone did little to explain the relationships between use and peer standing.¹

Substance use at this very young age is a relatively rare behavior. Results from the 2004 National Household Survey reveal that prevalence of current alcohol use and cigarette use increases considerably from 12–13 years (Substance Abuse and Mental Health Services Administration, 2005), suggesting that the 7th grade (ages 12–13) is an extremely important year for embarking on regular use. Thus, at the beginning of grade 7, regular use is both a new, and more importantly, a relatively *distinctive* behavior among children of this age. In the present sample, although almost half of the 7th graders report having tried alcohol or tobacco, only 1 in 7 reports current use.

Drinking and smoking are far from normative and this rule-breaking behavior may suggest both a willingness to break the rules and a level of surface maturity in these students. These adolescents may not only appear to be more sophisticated, perhaps due to their substance using behavior, but are in fact older and may be perceived as more mature. This perceived maturity and adult-like behavior in turn may influence their perceived popularity among their younger peers. So those who are visible users in the fall develop some cache and they are likely to possess other characteristics that render them visible, such as physical maturity.

Importantly, however, two-thirds of the students who *did* report current use at either time point reported drinking alcohol or smoking on only 1–2 days in the past month. Thus, not only is current use not very prevalent but it is also intermittent, at best. Plausibly, other students in the network may not have been aware of the substance-using behavior of their peers, negating the possibility of influence in this domain. However it is equally plausible, because of the rarity and distinctiveness of this behavior that others may have been very much aware of those few students who were willing to “break the rules.” Indeed it would seem likely that substance use among young adolescents occurs in dyadic or peer group contexts or is openly admitted or bragged about. Our interpretation is that this substance use behavior alone is too rare to effect any great impact on the peer standing, however the early initiation of substance use conveys to peers that the user is possessed of other appealing attributes that are valued in adolescent peer groups (such as sensation seeking, daring, and opposition to adult rules).

Buttressing this argument, we have found that use itself does not necessarily relate to popularity per se. Examination of the social network sociograms reveals that some of the users are located on the periphery, not only of their groups but to the point of being network isolates. New users in the spring could well be followers, not leaders, and the new spring users are likely on the periphery of groups and the network more generally. They may be the “wannabes” in Adler and Adler’s (1998) conception, those who want to be part of the higher status, popular clique. So what appears to be important is first or early use, not just use per se. Substance use in the latter part of the grade 7 school year might be employed to gain social status by those who are initially less preferred by peers.

That being said, users are perceived quite differently in the spring semester, both compared to how they were perceived in the fall and to how abstainers are viewed in the spring. First, and perhaps importantly, users are not significantly older than their peers in the spring. Whereas use was possibly an age-related or maturity level behavior in the fall, it no longer appears to

¹Users in the fall were somewhat older than abstainers, means=12.50 and 12.19, $t(154)=2.634$, $p<.01$. However, age was minimally related to just two variables in the fall and one in the spring, and the correlations, while significant, were small ($r_s < .20$). Moreover, partialling age from the bivariate correlations had only a very small effect on the size of the coefficients, leading us to discount the influence of age on our main study variables and findings.

be so. Second, users are no longer perceived as relatively more popular than abstainers. In fact, compared to users and abstainers in the fall, spring users are seen as relatively less popular and abstainers are seen as relatively more popular. A similar pattern emerges in the relative social impact of users and abstainers. For users, social impact is going down, whereas for abstainers, it is going up. Thus, users appear to lose their distinctiveness relative to their peers.

Reflecting back on our introduction to this paper, our findings point to the importance of taking a multidimensional approach to peer standing (Lease, Musgrove, & Axelrod, 2002), and employing multiple measures of group attachment, popularity, and peer group centrality (Gest et al., 2001). By developing both network and sociometric portrayals of individuals' placement among their peers we were able to discern that popularity diverges from centrality in those teens who were the early current users. Early in the school year, use was associated with the perception of the individual as "popular" and with occupying positions within the network from which influence is more likely to flow (i.e., Bonacich and betweenness centrality). By the middle of the spring term of the grade 7 year, just six months later, use is no longer associated with being perceived as popular by ones' peers, and users are less central, and therefore less likely to be transmitters of influence. These findings buttress those that suggest that spring users are those "wannabes" on the fringes of the network who perhaps turn to regular use as an entrée to the more powerful groups. This paper demonstrates the benefit of employing simultaneous systemic and individual measures of peer standing or group prominence, which, we argue, can help clarify the truly influential from the "pretenders" in the case of diffusion of risk-related behaviors.

Implications for prevention

Our findings appear to have important implications for prevention. There has been a recent move to incorporate social network analysis methods into prevention and intervention strategies, particularly in the domain of peer-led prevention programs. These strategies are predicated on understanding the value of knowing which adolescents are perceived of as popular or as leaders, and by whom, thereby taking advantage of grouping adolescents together based on their real-world social relationships (Valente et al., 2003). Our findings would suggest that the beginning of the fall of grade 7, or even as early as by the end of grade 6, is a propitious time for prevention programs to occur, particularly those programs that deal with peer resistance, the nature of popularity, and the effects of influence of others on one's behavior.

Our findings lend support to the important goal of identifying which adolescents hold power to influence their peers, and provide important considerations for substance use prevention in this early adolescent age group. Substance users appear to be very distinctive at this age, especially at the beginning of the school year. They are rated as more popular, have greater impact and are central to their groups. These users are older than their non-using peers and occupy well-connected and powerfully influential positions in the network. It is likely that their unique and distinctive behavior confers such elevated peer standing upon these adolescents. Such adolescents are likely to be "deviant leaders" (Miller-Johnson et al., 2003), who rate themselves as both able to influence others and as more susceptible to influence *from* others (Costanzo et al., 2005).

Another important implication of the present findings is that the tendency to view substance use as powerful in and of itself may be misguided. That is, we argue that it is not use per se that is powerful but rather, it is the adolescents who engage in early use that are powerful. Even when they don't use anymore, they retain that position of power within the peer network—it may well be, if one is doing a program based on peer leadership that those are the teens who might be best positioned to serve as change agents: that is, the kids who no longer use, who gain power in the context of use, and now retain that popularity. But, what is not known is, do these popular, powerful early adolescents no longer need to engage in visible rule-breaking

behavior to retain their power, or, have they moved onto other newer, and thus again, more distinctive behaviors? Are they moving into harder drugs, cutting school, precocious dating, or early sex? That is, are they continuing in their roles as the “leaders of the pack,” opinion leaders who beat back the brush of new behaviors, which their cohorts will then follow? These questions present interesting and important directions to explore with early users as they progress through adolescence.

Limitations and future directions

Our findings, while intriguing and potentially very important for informing prevention programs that utilize peers, are limited by the small samples of users generally, and smokers and drinkers more specifically. We would want to know if the findings reported above hold in a larger, representative sample. We would also want to follow these users over a longer time period to investigate to what extent they retain their positions of elevated peer standing throughout adolescence, and in what other domains of adolescent risk behavior they become precociously involved. Our findings may be limited to this particular age group: in other work with 13 yr-olds, Allen and colleagues (2005) noted that youth perceived as popular by their peers increased their use of alcohol and drugs over the course of the following year, when such behavior was approved of by their peers. It may be that in our sample, such behavior is not approved of, or as we suggested earlier, that alcohol use and cigarette smoking are perceived as differentially popular among adolescents at this age. Our conflation of the two types of users into one group may obscure the operation of separate processes. An important question that our limited sample of users prevented us from asking was, do smokers and drinkers gain and maintain similar positions within the peer groups of early adolescents? Preliminary analyses with the current sample suggest that they do not; it would be worthwhile to analyze smokers and drinkers separately to more carefully answer this question.

Another question that our small sample of users prevented us from addressing was the role of gender in the relation between peer standing and substance use. In the fall semester, there were approximately equal numbers of male and female users (12 and 10, respectively), while in the spring, females outnumbered males in the current users group (15 vs. 7). It may be plausibly asserted that one reason for higher peer standing among users in the fall compared to the spring is the presence of more male users in the fall. However, while we are limited in our ability to adequately test this possibility statistically, we note that in the sample as a whole, males and females did not differ on most measures of peer standing in the fall or spring (data not shown).

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References

- Adler, PA.; Adler, P. Peer power: Preadolescent culture and identity. Rutgers University Press; New Brunswick, NJ: 1998.
- Alexander C, Piazza M, Mekos D, Valente T. Peers, school and adolescent cigarette smoking. *Journal of Adolescent Health* 2001;29:22–30. [PubMed: 11429302]
- Allen JP, Porter MR, McFarland FC, Marsh P, McElhaney KB. The two faces of adolescents' success with peers: Adolescent popularity, social adaptation, and deviant behavior. *Child Development* 2005;76:747–760. [PubMed: 15892790]
- Aloise-Young PA, Kaepfner CJ. Sociometric status as a predictor of onset and progression in adolescent cigarette smoking. *Nicotine and Tobacco Research* 2005;7:199–206. [PubMed: 16036276]

- Black DR, Tobler N, Sciacca J. Peer helping/involvement: An efficacious way to meet the challenge of reducing alcohol, tobacco, and other drug use among youth? *Journal of School Health* 1998;68:87–93. [PubMed: 9608448]
- Bonacich P. Power and centrality: A family of measures. *American Journal of Sociology* 1987;92:1170–1182.
- Borgatti SP. Centrality and AIDS. *Connections*. 1995 18(1):112–115. from <http://www.analytictech.com/networks/centaids.htm>
- Bot SM, Engels RCME, Knibbe RA, Meeus WH-J. Friend's drinking behavior and adolescent alcohol consumption: The moderating role of friendship characteristics. *Addictive Behaviors* 2005;30:929–947. [PubMed: 15893090]
- Cairns, RB.; Cairns, BD. *Lifelines and Risks: Pathways of Youth in Our Time*. Cambridge University Press; Cambridge, England: 1994.
- Cairns, RB.; Garipey, J-L.; Kindermann, TA. Identifying social clusters in natural settings. Social Developmental Laboratory, University of North Carolina at Chapel Hill; 1989. Unpublished manuscript
- Cairns RB, Leung M-C, Buchanan L, Cairns BD. Friendships and social networks in childhood and adolescence: Fluidity, reliability, and interrelations. *Child Development* 1995;66:1330–1345. [PubMed: 7555219]
- Cillessen AHN, Rose AJ. Understanding popularity in the peer system. *Current Directions in Psychological Science* 2005;14:102–105.
- Coie JD, Dodge KA, Copotelli H. Dimensions and types of social status. *Child Development* 1982;59:815–829. [PubMed: 3383681]
- Costanzo, P.; Lansford, J.; Arrington, K.; Chu, R.; Polanichka, N. Factors that differentiate deviant and conventional leaders of adolescent peer groups: Implications for drug use prevention efforts; Presented at the Annual Meeting of the Society for Prevention Research; Washington, DC. 2005.
- de Bruyn EH, van den Boom DC. Interpersonal behavior, peer popularity, and self-esteem in early adolescence. *Social Development* 2005;14:555–573.
- DeRosier ME, Thomas JM. Strengthening sociometric prediction: Scientific advances in the assessment of children's peer relations. *Child Development* 2003;75:1379–1392. [PubMed: 14552404]
- Dishion TJ, Capaldi D, Spracklen KM, Li F. Peer ecology of male adolescent drug use. *Development and Psychopathology* 1995;7:803–824.
- Dishion TJ, Capaldi D, Yoerger L. Middle childhood antecedents to progression in male adolescent substance use: An ecological analysis of risk and protection. *Journal of Adolescent Research* 1999;14:175–204.
- Dishion TJ, Skaggs N. Medici. An ecological analysis of monthly "bursts" in early adolescent substance use. *Applied Developmental Science* 2000;4:89–97.
- Donaldson SI, Sussman S, MacKinnon DP, Severson HH, Glynn T, Murray DM, Stone EJ. Drug abuse prevention programming: Do we know what works? *American Behavioral Scientist* 1996;39:868–883.
- Engels RCME, Knibbe RA, Drop MJ, de Haan YT. Homogeneity of cigarette smoking within peer groups: Influence or selection? *Health Education and Behavior* 2005;24:801–811. [PubMed: 9408792]
- Ennett SE, Baumann KE. Peer group structure and adolescent cigarette smoking: A social network analysis. *Journal of Health and Social Behavior* 1993;34:226–236. [PubMed: 7989667]
- Ennett SE, Baumann KE. The contribution of influence and selection to adolescent peer group homogeneity: The case of adolescent cigarette smoking. *Journal of Personality and Social Psychology* 1994;67:653–663. [PubMed: 7965611]
- Ennett ST, Bauman KE, Hussong A, Farris R, Foshee VA, DuRant RH, Cai L. The peer context of adolescent substance use: Findings from social network analysis. *Journal of Research on Adolescence* 2006;28:159–186.
- Farmer TW, Rodkin PC. Antisocial and prosocial correlates of classroom social positions: The social network centrality perspective. *Social Development* 1996;5:174–188.
- Flom PL, Friedman SR, Jose B, Curtis R. Peer norms regarding drug use and drug selling among household youth in a low-income 'drug-supermarket' urban neighborhood. *Drugs-Education Prevention and Policy* 2001;8:219–232.

- Freeman L. Centrality in social networks: Conceptual clarification. *Social Networks* 1979;1:215–39.
- Gest SD, Graham-Bermann SA, Hartup WW. Peer experience: Common and unique features of number of friendships, social network centrality, and sociometric status. *Social Development* 2001;10:23–39.
- Granovetter MS. The strength of weak ties. *American Journal of Sociology* 1973;78:1360–1380.
- Hanneman, RA. Introduction to Social Networks. [Retrieved 11/06/2005]. (n.d.)from <http://faculty.ucr.edu/~hanneman/networks/nettext.pdf>
- Harrison PA, Fulkerson JA, Park E. The relative importance of social versus commercial sources in youth access to tobacco, alcohol, and other drugs. *Preventive Medicine: An International Devoted to Practice and Theory* 2000;31:39–48.
- Hawley PH. The ontogenesis of social dominance: A strategy-based evolutionary perspective. *Developmental Review* 1999;19:97–132.
- Jiang XL, Cillessen AHN. Stability of continuous measures of sociometric status: A meta-analysis. *Developmental Review* 2005;25:1–25.
- Johnston, LD.; O'Malley, PM.; Bachman, JG.; Schulenberg, JE. Monitoring the Future national results on adolescent drug use: Overview of key findings, 2004. National Institute on Drug Abuse; Bethesda, MD: 2005. (NIH Publication No. 05-5726)
- Guidelines for school health programs to prevent tobacco use and addiction. *Journal of School Health* 1994;64:353–360. [PubMed: 7877276]*Journal of School Health*
- Kandel DB. Homophily, selection and socialization in adolescent friendships. *American Journal of Sociology* 1978;84:427–436.
- Knoke, D.; Kulinski, JH. Network Analysis. In: Sullivan, JL.; Niemi, RG., editors. Series: Quantitative Applications in the Social Sciences. Sage; Beverley Hills, CA: 1982.
- LaBrie J, Pedersen E, Earleywine M. A group-administered Timeline Followback assessment of alcohol use. *Journal of Studies on Alcohol* 2005;66:693–697. [PubMed: 16329460]
- LaFontana KM, Cillessen AHN. Children's interpersonal perceptions as a function of sociometric and peer-perceived popularity. *Journal of Genetic Psychology* 1999;160:225–242.
- Latane B. The psychology of social impact. *American Psychologist* 1981;36:343–356.
- Lease AM, Musgrove KT, Axelrod JL. Dimensions of social status in preadolescent peer groups: likability, perceived popularity, and social dominance. *Social Development* 2002;11:508–533.
- Miller-Johnson S, Costanzo PR, Coie JD, Rose MR, Browne DC, Johnson C. Peer social structure and risk-taking behaviors among African American early adolescents. *Journal of Youth and Adolescence* 2003;32:375–384.
- Newcomb AF, Bukowski WM, Pattee L. Children's peer relations: A meta-analytic review of popular, rejected, neglected, controversial, and average sociometric status. *Psychological Bulletin* 1993;113:99–128. [PubMed: 8426876]
- Newman MEJ. The structure and function of complex networks. *SIAM Review* 2003;45:167–256.
- North, SC. Drawing graphs with NEATO. [Retrieved 10/08/2005]. 2002 from <http://www.graphviz.org/Documentation/neatoguide.pdf>
- Olds RS, Thombs DL. The relationship of adolescent perceptions of peer norms and parent involvement to cigarette and alcohol use. *Journal of School Health* 2001;71:223–228. [PubMed: 11512489]
- O'Malley PM, Johnston LD, Bachman JG, Schulenberg J. A comparison of confidential versus anonymous survey procedures: Effects on reporting of drug use and related attitudes and beliefs in a national study of students. *Journal of Drug Issues* 2000;30:35–54.
- Parkhurst JT, Hopmeyer A. Sociometric popularity and peer-perceived popularity: Two distinct dimensions of peer status. *Journal of Early Adolescence* 1998;18:125–144.
- Pearson M, West P. Drifting smoke rings: Social network analysis and Markov processes in a longitudinal study of friendship groups and risk-taking. *Connections* 2003;25:59–76.
- Rodkin PC, Farmer TW, Pearl R, Van Acker R. Heterogeneity of popular boys: Antisocial and prosocial configurations. *Developmental Psychology* 2000;36:14–24. [PubMed: 10645741]
- Substance Abuse and Mental Health Services Administration. Results from the 2004 National Survey on Drug Use and Health: National Findings. Rockville, MD: Office of Applied Studies; 2005. NSDUH Series H-28DHHS Publication No. SMA 05-4062

- Tani CR, Chavez EL, Deffenbackher JL, et al. Peer isolation and drug use among White non-Hispanic and Mexican-American adolescents. *Adolescence* 2001;36:127–139. [PubMed: 11407629]
- Thornberry, TP.; Krohn, MD. Peers, drug use, and delinquency. In: Stoff, DM.; Breiling, J.; Maser, JD., editors. *Handbook of antisocial behavior*. Wiley; New York: 1997. p. 218-233.
- Urberg KA, Degirmencioglu SD, Pilgrim C. Close friend and group influence on adolescent cigarette smoking and alcohol use. *Developmental Psychology* 1997;33:834–844. [PubMed: 9300216]
- Valente TW, Hoffman BR, Ritt-Olson A, Lichtman K, Johnson CA. Effects of a social-network method for group assignment strategies on peer-led tobacco prevention programs in schools. *American Journal of Public Health* 2003;93:1837–1843. [PubMed: 14600050]
- Valente TW, Unger JB, Johnson CA. Do popular students smoke? The association between popularity and smoking among middle school students. *Journal of Adolescent Health* 2005;37:323–329. [PubMed: 16182143]
- Wallace JM, Bachman JG. Validity of self-reports in student based studies on minority populations: Issues and concerns. *Substance Use and Misuse* 1997;32:1949–1954.
- Wasserman, S.; Faust, K. *Social Network Analysis: Methods and Applications*. Cambridge University press; New York: 1994.

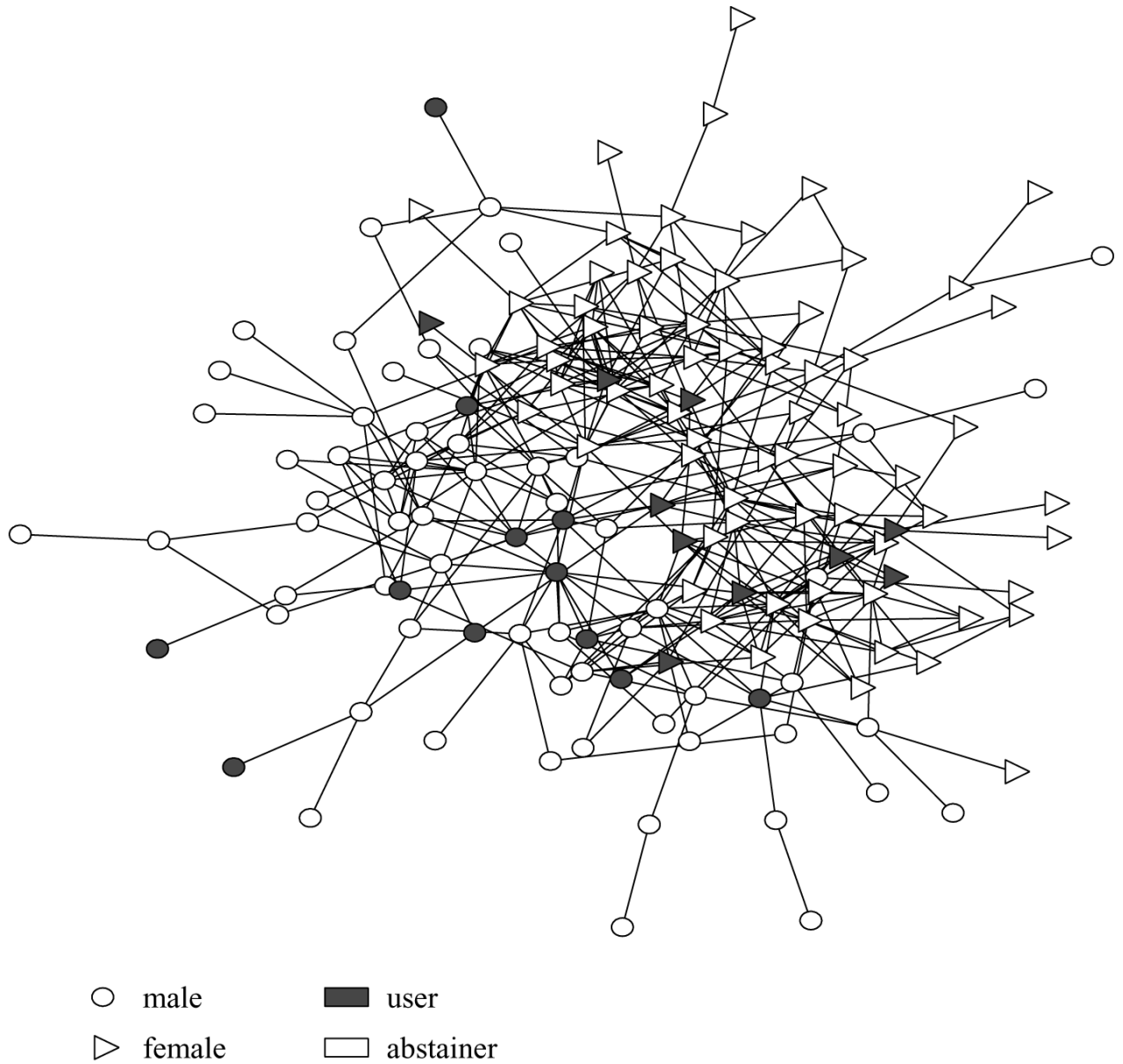


Fig. 1. Seventh grade network in the fall semester. Density=0.080, number of isolates=17 (10%), density w/isolates included=0.066, mean distance=3.616, clustering coefficient=0.163

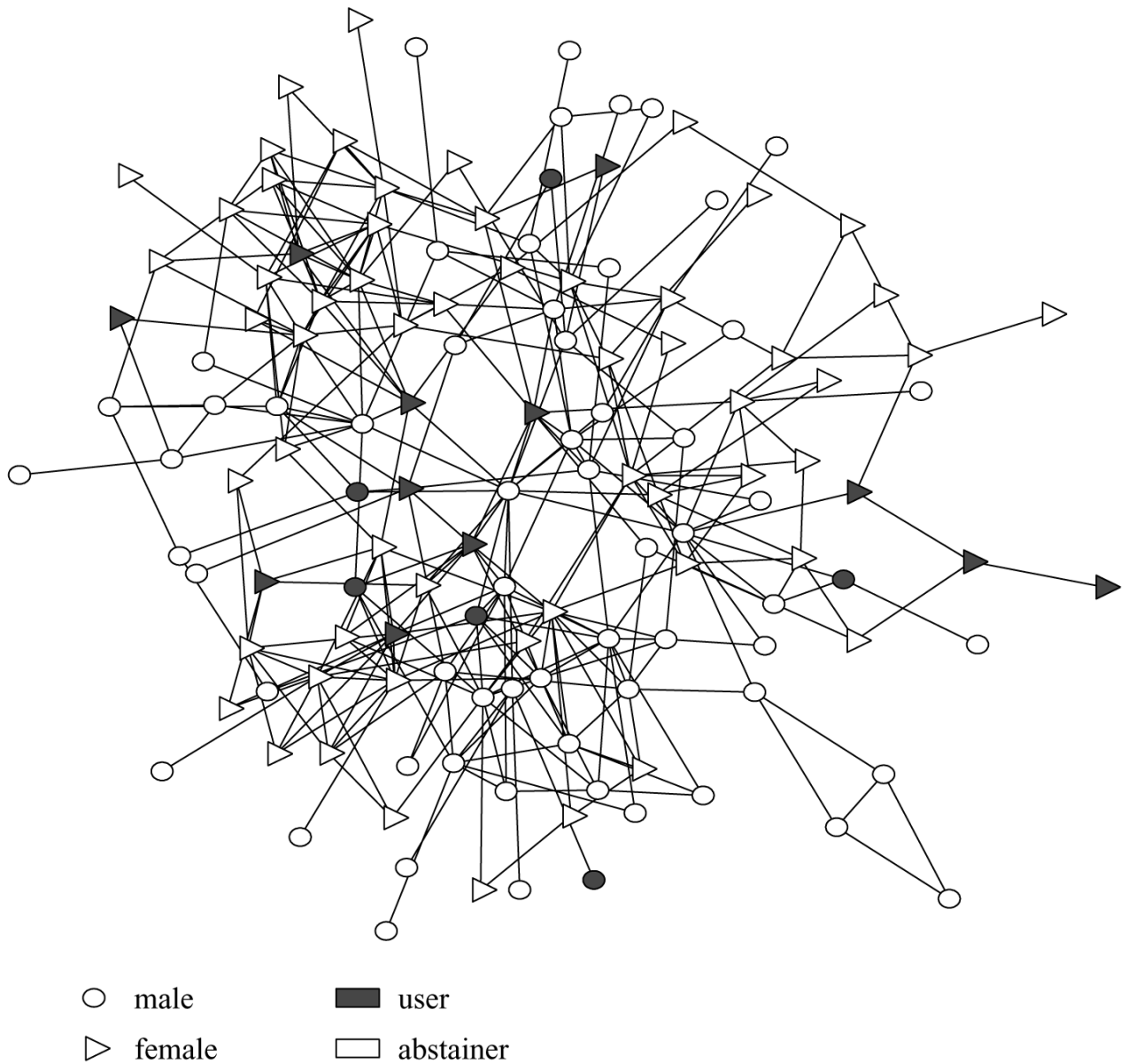


Fig. 2. Seventh grade network in the spring semester. Density=0.084, number of isolates=24 (20%), density w/isolates included=0.057, mean distance=3.606, clustering coefficient=0.185

Table 1

Comparisons of users and abstainers on measures of individual, group and network peer standing

	Fall		Spring	
	Users	Abstainers	Users	Abstainers
Social preference ^a	0.051	0.028	0.146	-0.095
Social impact ^a	0.698	-0.201 ^{***}	0.279	-0.081
Perceived popularity ^a	0.420	-0.160 ^{**}	-0.036	-0.102
Individual centrality ^b	0.799	0.690	0.557	0.693 [*]
Nuclear ^c	63.2	53.1	22.7	55.0
Secondary	26.3	33.6	72.7	34.1
Peripheral	10.5	13.3	4.6	10.9
Group centrality ^d	0.371	0.309	0.607	0.479 [*]
Nuclear ^c	15.8	7.8	0.0	0.0
Secondary	36.8	29.7	72.7	52.7
Peripheral	47.4	62.5	27.3	47.3
Network centrality ^e	1.684	1.445	2.227	2.527 [*]
Betweenness ^f	0.008	0.004 [*]	0.005	0.004
Bonacich centrality ^f	1.109	0.706 ^{**}	0.798	0.707

Notes. Asterisks denote significant difference between users and abstainers within semester.

^a Social preference, social impact and perceived popularity are z scores, standardized within semester.

^b Individual centrality=ratio of total number of nominations of “kids who hang around together a lot” received to the average number of nominations received by the top two members of the group.

^c Individual and group centrality scores were recoded into nuclear (ratios 0.7 to 3.0), secondary, (ratios 0.3 to 0.6999.), and peripheral (ratios 0 to 0.2999.) statuses. Pearson chi-square for Individual centrality in the spring semester, $\chi^2=11.706$, $df=2$, $p < .01$.

^d Group centrality=ratio of the average number of nominations received by the top two members of the group to the average of the top two groups.

^e Network centrality is indexed by the lower of the individual and group centrality scores.

^f Betweenness and Bonacich centrality measures are not comparable within columns, as each is on a different metric. Values within rows, however, are comparable. Smaller values indicate less centrality.

* $p < .05$

** $p < .01$

*** $p < .001$

Table 2

Correlations, means, and standard deviations for study variables, Fall semester (Time 1)

	1	2	3	4	5	6	7	8	9
1 Users Fall ^d	-	0.02	0.33***	0.22**	0.13	0.11	0.12	0.20*	0.21**
2 Social Pref		-	0.19*	0.53***	0.22**	0.54***	0.55***	-0.01	0.24**
3 Social Impact			-	0.67***	0.16	0.49***	0.43***	0.13	0.27***
4 Popularity				-	0.12	0.63***	0.62***	0.05	0.16*
5 Ind. Centr					-	0.47***	0.42***	0.07	0.12
6 Grp Centr						-	0.87***	-0.05	0.16**
7 Ntwk Centr							-	0.02	0.22
8 Betweeness								-	0.68***
9 Bonacich									-
Mean	12.8%	0.031	-0.086	-0.085	0.70	0.32	1.48	0.005	0.758
SD		0.924	0.886	0.911	0.31	0.23	0.65	0.006	0.645
N	156	156	156	156	147	147	147	156	156

^d Spearman correlation coefficients are reported for relationships with the dichotomous Users variables. All other values reported are Pearson correlation coefficients.

* $p < .05$

*** $p < .01$

Table 3

Correlations, means, and standard deviations for study variables, Spring semester (Time 2)

	1	2	3	4	5	6	7	8	9
1 Users Spring ^a	-								
2 Social Pref		0.07							
3 Social Impact			0.12						
4 Popularity			0.20*	0.13	-0.19*	0.22**b	-0.21**	0.04	0.04
5 Ind. Centr				0.65***	0.30***	0.37***	0.25**	-0.06	0.09
6 Grp. Centr				0.53***	0.10	0.41***	0.15	0.13	0.21**
7 Ntwk Centr					0.25**	0.55***	0.25**	0.03	0.07
8 Betweeness						-0.12	0.87***	0.09	0.15
9 Bonacich							-0.06	-0.06	0.15
Mean	14.0%	-0.061	-0.030	-0.093	0.67	0.50	2.48	0.004	0.719
SD		0.999	1.001	0.926	0.28	0.24	0.54	0.006	0.733
N	156	156	156	156	151	151	151	156	156

^a Spearman correlation coefficients are reported for relationships with the dichotomous Users variables. All other values reported are Pearson correlation coefficients.

^b Preliminary analyses based on sub-samples with limited *ns* suggest that the relationship between use and group centrality in the spring differs for smoking and drinking, Spearman *rs*=.09, *ns.*, and .23, *p* < .01, respectively.

* *p* < .05

** *p* < .01