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Mental Health, School Problems, and Social Networks: Modeling Urban Adolescent Substance Use

Michael J. Mason

Department of Education & Human Services, Villanova University, St. Augustine Center, 800 Lancaster Ave., Villanova, PA 19010, USA

Michael J. Mason: Michael.mason@villanova.edu

Abstract

This study tested a mediation model of the relationship with school problems, social network quality, and substance use with a primary care sample of 301 urban adolescents. It was theorized that social network quality (level of risk or protection in network) would mediate the effects of school problems, accounting for internalizing problems and relations with parents, on substance use. Results of path modeling with AMOS showed that the model provided a very good fit to the data and demonstrated partial mediation effects of social network quality on substance use. The standardized mediated effect of school problems on substance use, mediated by social network quality, was 0.13 ($p < .01$, 95% CI [.072, .189]). An effect size measure was applied to determine what proportion of the total effect was mediated by the intervening (social network quality) variable and produced a 0.34 effect size. The results highlight the potential preventive role of social network quality in addressing urban adolescent substance use.

Keywords

Social networks; Urban adolescents; Substance use; School problems; Mental health; Mediation analysis

Introduction

Efforts to prevent adolescent substance use are predicated on understanding the multifaceted processes associated with this complex health behavior. For example, substance use is sustained by reciprocal psychosocial forces that shape peer group selection and influence health behaviors (Alexander et al. 2001). Influencing these forces is the fluid nature of peer contexts (Mason et al. 2010), which are continually shaped by developmental tasks such as emotional regulation and peer socialization that then impact health behaviors (Bandura 2005; Masten et al. 1995; Zahn-Waxler et al. 2006). Given the prominence of peers in the social lives of adolescents and the salience of the educational context, the present study was designed to examine the role of social networks in order to specify the interrelated psychosocial influences on substance use involvement in urban adolescents. The purpose of the present study is to investigate the role of social network quality, conceptualized along a risk/protective continuum, in mediating the influences of school problems, accounting for internalizing problems and relations with parents on substance use.

Social Networks and Substance Use

Research on social networks has suggested that peer context is a robust predictor of adolescent substance use (Mayes and Suchman 2006; Unger and Chen 1999; Valente et al. 2005). Specifically, social network research focused on the processes of adolescent substance use uptake has identified two distinct social-behavioral mechanisms: (a) social influence, in which substance use is a product of peer use, and (b) peer selection, in which adolescents associate with others based on their prior behaviors such as substance use (Bauman and Ennett 1996; Hussong 2002). However, recent research has integrated these mechanisms with prospective studies providing support for the influence of both mechanisms on substance use (Cotterell 2007; Curran et al. 1997; Kirke 2006; Wills and Cleary 1999). It may be that social networks cannot be completely understood through a single, linear cause-effect model, but rather, like the interactive nature of adolescent social development, social networks are best understood through mediating influences on actors, the network quality, and the context in which the developmental processes are experienced (Cotterell 2007; Bronfenbrenner 1979; Hussong 2002; Kirke 2006). This approach acknowledges both peer selection and influence as important constructs in understanding adolescent substance use.

Substance use among adolescents continues to be a public health concern with differences in uptake, abuse, and dependency varying by age and gender. For example, it is well established that age is positively associated with substance use and that males typically use more substances compared to females. However, these patterns appear to be shifting. Although males are more likely than females to be current substance users, the rate of substance use among females aged 12 or older increased from 5.8% in 2007 to 6.3% in 2008. Conversely, the rate did not change significantly for males (Substance Abuse Mental Health Services Administration 2009). The influence of gender as an explanation for substance use based upon varying network qualities provides a promising interpretative framework for understanding adolescent substance use. For example, studies have explained increases in substance use in girls in terms of disturbances in their social relationships, which may influence substance use in the form of self-medication (Wills et al. 2002; Windle 1990; Zahn-Waxler et al. 2006). This research suggests that, given that girls are more likely to derive psychologically relevant information about themselves and others through interpersonal relationships, they are more vulnerable when they encounter interpersonal distress and therefore often experience increased disturbance when their relational ties are threatened, particularly with friends.

School Problems, Mental Health, and Adolescent Substance Use

A robust body of research documents the relationship between school problems, mental health, and the use of substances among adolescents (Costello et al. 1999; Kandel et al. 1999; Grella et al. 2001). Relative to the present study, many urban youth are disproportionately exposed to trauma (e.g., violence, crime), which increases vulnerability to substance use (Costello et al. 2002; Kilpatrick et al. 2000). Specifically, early exposure to trauma and subsequent development of post-traumatic stress disorder symptoms can interfere with emotional regulatory tasks and lead to further internalizing problems (Lubit 2005; Mayes and Suchman 2006). These psychological problems interfere with school performance and can contribute to withdrawal and negative attitudes toward school. These negative attitudes toward the educational environment increases the likelihood of associating with peers who have lower commitment to school, share poor academic achievement, lack adherence to conventional societal norms, and are thereby more accepting of substance use as a coping or social activity (Wills et al. 2001; Hawkins et al. 1992).

The risk-exacerbating influence of social networks continues through active involvement with a deviant peer group, which has been shown to further solidify negative attitudes towards school and to sustain a trajectory toward ongoing substance use involvement (Ialongo et al. 2001; Mayes and Suchman 2006). In contrast, prosocially oriented social networks can serve as protective mechanisms against substance use (Bauman and Ennett 1996) as well as against mental health disturbances (Mason 2009). In fact, research supports the salience and influence of peer networks, over and above the influence of family, in predicting adolescent substance use initiation as well as school misconduct, particularly with adolescents exposed to trauma (O'Donnell et al. 2002).

Primary Care Settings and Prevention Practice

Of significant concern is that of the adolescents who meet criteria for substance abuse or dependency, less than 10% receive intervention services (Substance Abuse and Mental Health Services Administration 2007). Efforts to find appropriate settings to address adolescent substance use have resulted in the identification of primary care as an important venue to address to this issue. Due to the typically non-threatening nature of primary care settings, clinicians have unique access to patients with substance abuse problems. For example, patients classified as at-risk drinkers are often reluctant to receive services from an addiction specialist, yet two-thirds of these patients will see their general practitioner each year (World Health Organization Europe 2001). Moreover, attending to substance use issues within primary care has shown to increase access, retention, and improve health outcomes (Friedmann et al. 2003; Saitz et al. 2005). Relative to prevention practice, addressing substance use within primary care settings provides opportunities for all levels of prevention interventions within a non-threatening context and thus can improve outcomes.

In summary, the theoretical model for the present study is as follows: Adolescents' poor relations with their parents can be either a result of internalizing problems or vice versa. These mental health problems can then influence dissatisfaction and lack of comfort with the educational context. The social operation of substance use uptake then occurs in two steps, much like a two-stage model of peer influence (Urberg et al. 2003). First, school problems can lead to the selection of a like-minded, high-risk peer group, one that has less prosocial group norms and is more likely to support the use of substances. Next, within the context of this high-risk peer group, influence to use substances can be understood through peer modeling as ways to cope with mental health issues such as internalizing problems and poor relations with parents. Substance use (e.g., alcohol and marijuana) behaviors can be interpreted as being constituted within a selected social network that influences through peer modeling of this behavior and supported opportunities to cope with mental health and familial issues (Bandura 2005). Thus, as a reaction to mental health and parental relations issues, the adolescent struggles with the educational process and selects like-minded peers that then influence the use of substance as a coping mechanism. This process operates on the selection and subsequent influence of peers who use substances. Figure 1 shows a model representing this theoretical explanation with the timing of pathways as well as the placement of moderating and mediating variables.

Based upon the literature reviewed and the proposed theoretical model, this study sought to test whether social network quality (level of risk or protection) would mediate the effects of school problems, accounting for internalizing problems and relations with parents, on substance use. It was hypothesized that social network quality would mediate the effects of school problems on substance use across all groups. Secondly, based on previous work with this sample (Mason et al. 2010), it was hypothesized that social network quality would be more protective for girls and younger teens against the effects of school problems on substance use compared to boys and older teens.

Methods

Participants & Setting

The sample comprised 301 adolescent primary care patients at a Philadelphia Department of Public Health health care center. The health care center offers comprehensive medical care to entire families such as medical check-ups, family planning, pregnancy options counseling, prenatal care, well-baby care, mobile crisis psychiatric services, blood tests, X-rays, medication, baby shots, flu shots for older adults, and TB immunizations. Adolescents are typically seen for medical check-ups, routine health care, and family planning services. Patients that do not have insurance are billed on a sliding scale based on family size and income. The Center is staffed with a comprehensive primary care medical staff consisting of physicians, nurse practitioners, registered nurses, and social workers as well as office staff and administration. Table 1 presents demographic data for this sample. As indicated in the table, the sample was 87% African American and 13% self-identified as mixed or other race/ethnicity, with the majority (60%) female, which corresponds with other primary care gender distributions (Mason et al. 2004). The high African American rate is representative of the urban area served by the health care center. Nearly one-third (30%) of subjects were living below the poverty line and 14% were on public assistance. Participants were eligible for the study if they were between the ages of 13 and 20 years, had a Philadelphia residence, were free from major mental health disturbance (e.g., active psychosis would exclude a patient from completing the interviews), were literate or fluent in English, and, for minor patients, were accompanied by parents or legal guardians capable of providing informed consent.

Procedure

Between January and October 2008, parents or guardians of all adolescent patients were approached in the clinic waiting area, the study was explained, and eligibility screening questions were asked. Families who met eligibility requirements were recruited to participate in the study. Adolescents over 18 were approached directly while they waited for their appointments; on average, 5–8 adolescents were seen at the clinic daily. Written informed consent was obtained from all parents and/or adolescent participants. Nominal incentives were used to acknowledge participants' time and effort, and the study's consent rate was 90%. Measures were administered in private (i.e., in a separate room from parents to protect patient confidentiality and obtain more valid data), and the procedure generally lasted 45 min or less. The first author's university and the City of Philadelphia Health Department's institutional review boards approved the research protocol, and the study received a federal certificate of confidentiality.

Measures

All assessments were conducted by trained interviewers who completed a training protocol that included role-play training and ongoing weekly supervision to ensure the collection of high-quality data. Individual background characteristics such as age, sex, race/ethnicity, and social economic status of all participants were assessed.

Substance Involvement Measure—Substance involvement was measured with the Adolescent Alcohol and Drug Involvement Scale (AADIS; Moberg and Hahn 1991). The AADIS is a brief measure of the level of alcohol and drug involvement in adolescents for use as a research tool and is highly accurate in differentiating between those who do not have any substance use disorders and those that have at least one (Winters 2003). The AADIS has favorable internal consistency reliability (Cronbach's $\alpha = .94$) and correlates highly with self-report measures of substance use ($r = .72$), with clinical assessments ($r = .75$), and with subjects' perceptions of the severity of their own drug use problem ($r = .79$); it

had a Cronbach's α of .83 for the present study. Higher scores represent greater levels of alcohol and drug involvement, with scores of 37 and above indicating increased likelihood of a DSM-IV-TR criteria being met for abuse or dependency.

Social Network Measure—Social network data were gathered using the Adolescent Social Network Assessment (ASNA; Mason et al. 2004). The ASNA captures information on each person's close personal contacts, their strong ties which constitute their social networks. The ASNA has favorable internal consistency reliability (Cronbach's $\alpha = .84$) and correlates significantly in the expected direction with self-report measures of substance use ($r = -.64$), with self-report alcohol use ($r = -.66$), and with self-reported marijuana use ($r = -.54$). Adolescents are asked to name the people with whom they have contact at least once per month and with whom they have a "meaningful relationship." Participants provide health risk information on each alter (peers identified in network). A participant is asked whether each alter uses substances, how often, and whether participants have been influenced to use or not use substances by each alter. This item has been shown in past research to be an important influence on behavior (Valente et al. 1997). Subjects are asked about positive activities such as receiving help with school, work, or transportation; talking through problems; or providing support. Negative activities include substance use, illegal activities, violence, or high-risk sexual activity (e.g., sex with no condom, sex with a person with HIV/AIDS or of unknown HIV status). These procedures follow those widely used and accepted in the social network field (Burt 1984, 1992; Brewer 2000; Cotterell 2007; Liebow et al. 1995; Marsden 1990; Valente 2003; Vehovar et al. 2008).

Responses are given weighted values of 1–6 forming a possible range of –70 to 70, with higher scores indicating more protection and lower scores indicating more risk. Weights are based upon research that has shown risk for substance use increases with one substance user in a network and that risk for mental health problems is elevated with one daily substance user in a network (e.g., threefold increase; Mason 2009; Mason et al. 2004). Given these data, the following weighted scoring procedures were developed: for Risk Quality, substance user = –1, daily user = –3, negative activity = –4, influence to use = –6, and for Protective Quality, non-substance user = 4, absence of negative activities = 4, influence not to use = 6.

School Problems and Mental Health Measures—School problems and mental health (internalizing problems and relations with parents) was measured using the Behavior Assessment System for Children (BASC-2) Self-Report of Personality (Reynolds and Kamphaus 2004). The BASC-2 was used for its ability to measure clinical (maladjustment) as well as adaptive (positive adjustment) dimensions and allows researchers to choose either general or clinical sample norm groups. For the present study, the general combined-sex norm group was used. Reliability is strong with the BASC-2 having internal consistency scores of composites with α coefficients ranging from the low to mid .90 s. In the present study, the clinical composite School Problems was used (Cronbach's $\alpha = .86$), which is a broad measure of adaptation to school. It includes 3 scales: Attitude Toward School (i.e., level of comfort with school-related matters), Attitude Toward Teachers (i.e., perception of teachers regarding level of care, fairness, motivation to help), and Sensation Seeking (i.e., need for varied, novel, complex experiences and willingness to take risks associated with these experiences). This composite provides an understanding of the teens' relationship to school and the setting and structure of the educational process. The composite produces continuous data with higher scores indicating greater level of problems.

The Internalizing Problems composite was used to measure inwardly directed distress including atypicality, locus of control, social stress, anxiety, depression, and sense of inadequacy (Cronbach's $\alpha = .96$). The composite produces continuous data with higher scores

indicating greater level of problems. The Relations with Parents scale was also used to measure adolescents' perception of being important in the family, the status of the parent-child relationship, and the child's perception of the degree of parental trust and concern (Cronbach's $\alpha = .89$). The scale produces continuous data with lower scores indicating greater levels of problems.

Analytic Plan

The overall goal of the analysis was to test whether Social Network Quality mediates School Problems' effects on Substance Use while accounting for Internalizing Problems and Relations with Parents and controlling for gender and age. Initial bivariate correlations were conducted among variables of interest and were found to be significantly correlated in the expected direction. A chi-square analysis of the level of School Problems by gender and age groups was conducted, and no significant differences were found ($p > .05$). Next, exploratory analyses using OLS regression were conducted to determine if the mental health variables were related to each other and to School Problems and to see if School Problems, Social Network Quality, and Substance Use were related. All exogenous (Internalizing Problems, Relations with Parents), predictor (School Problems), and mediator (Social Network Quality) variables were statistically significant in the expected direction ($p < .05$) and therefore were retained in the subsequent path analyses. Due to the literature on sensation seeking and substance use, each of the three scales that make up the School Problems Composite (Attitude Toward School, Attitude Toward Teacher, and Sensation Seeking) were tested for their association with the Substance Use variable to determine if the composite was being primarily driven by Sensation Seeking. Attitudes Toward School ($r = .232, p < .01$) and Teachers ($r = .186, p < .01$) were more strongly and significantly correlated with Substance Use compared to Sensation Seeking ($r = .137, p < .05$). This increases confidence that the composite's association with Substance Use is related to a broad pattern of dissatisfaction within the educational context, personnel, and the general structure.

To determine whether the impact of School Problems on Substance Use was mediated by Social Network Quality, a series of path models were tested using AMOS (Version 17). In order to empirically test model invariance by gender and age groups (13–16 and 17–20 years old), multigroup path analyses were conducted to determine the model's fit with each group. Four separate data sets were created based on gender and age groups. Each data set was tested twice, where initially all parameters were fixed to be invariant across gender and age groups. Following, all parameters were free to vary across all groups (Byrne 2004). If the chi-square difference statistic did not reveal a significant difference between the multigroup models, then it could be reasonably concluded that the model as drawn has invariance across groups; that is, the model applies equally across groups (Vandenberg and Lance 2000). All missing data (<1% of cases by group) were imputed through the AMOS regression imputation maximum likelihood procedure (Blunch 2008). Bootstrapping was used for testing significance of the mediated effects and to produce percentile confidence intervals (MacKinnon 2008).

Results

Descriptive Statistics

Substance Use scores ranged from 0 to 67 with a mean score of 18.5 ($SD = 18.3$), with 11% reporting weekly or daily use and 18% reporting at-risk levels of substance use, that is, likely to qualify for substance abuse or dependency. Social Network Quality scores ranged from -70 to 70 with a mean score of 36.3 ($SD = 26.8$). School Problems scores ranged from 31 to 77 with a mean of 49.9 ($SD = 8.9$) and 11% in the at-risk range (90th percentile).

Relations with Parents scores ranged from 24 to 68, with a mean of 47.2 ($SD = 10.5$) and 25% in the at-risk range (90th percentile). Internalizing Problems scores ranged from 32 to 85 with a mean of 49.3 ($SD = 10.1$) and 13% in the at-risk range (90th percentile). Table 2 shows the results of the partial correlations among variables of interest, controlling for gender and age. The predictor variable, School Problems, was significantly correlated with both Social Network Quality and Substance Use ($p < .001$), and both exogenous variables (Internalizing Problems and Relationship with Parents) were significantly correlated to School Problems ($p < .05$).

Model Invariance

The initial multigroup test of invariance (constrained) examined both the gender and then the age models to determine whether regression structural weights for variables were the same in value across groups. The test on the gender model revealed a very good fit to the data with a nonsignificant chi-square, $\chi^2 (13, N = 301) = 8.736, p = .793$, indicating no significant difference between the hypothesized model and the data. Based upon Hu and Bentler's (1999) recommendations, the fit indices selected for further evaluation of the model included root-mean-square error of approximation (RMSEA; recommended level $< .10$; obtained = .00001), the normed fit index (NFI; recommended level $> .90$; obtained = .97), and the comparative fit index (CFI; recommended level $> .95$; obtained = 1.000). The test on the age model also revealed a very good fit to the data, $\chi^2 (13, N = 301) = 9.413, p = .741$, RMSEA (.0001), NFI (.97), and CFI (1.000). Next, models were examined without restrictions on parameters. The test on the gender model revealed a very good fit to the data, $\chi^2 (8, N = 301) = 6.874, p = .550$, RMSEA (.0001), NFI (.98), and CFI (1.000). The test on the age model also revealed a very fit good to the data, $\chi^2 (8, N = 301) = 5.708, p = .680$, RMSEA (.0001), NFI (.98) and CFI (1.000).

Finally, a test of differences between groups showed no significant differences between free and fixed models, assuming the free model to be correct for gender, $\Delta\chi^2 (5) = 16.57, p = .868$, or for age, $\Delta\chi^2 (5) = 3.705, p = .593$, indicating that these groups are statistically indistinguishable. Based on these results, one path model was used for testing with the entire sample.

Full-Sample Path Model

Results of the full-sample path modeling analysis showed that the model provided a very good overall fit to the data and demonstrated partial mediation affects of Social Network Quality on Substance Use. Bootstrapping was used to test the significance of the mediated effects for the model. Figure 2 shows the path model with direct standardized coefficients. The chi-square was not significant, $\chi^2 (4, N = 301) = 3.545, p = .471$. Fit indices included root-mean-square error of approximation (.0001), the normed fit index (.99), and the comparative fit index (1.000). The standardized mediated effect of School Problems on Substance Use, mediated by Social Network Quality, was 0.13 ($p < .01$, 95% CI = [.072, .189]). An effect size measure was applied to determine what proportion of the total effect is mediated by the intervening variable (Social Network Quality). This effect size measure is adequate if all estimates are statistically significant and is used with a single mediator model (MacKinnon 2008). Referred to as the R^2 proportion, it represents the squared correlation between X (predictor variable, School Problems) and M (mediating variable, Social Network Quality) times the squared partial correlation between M and Y (dependent variable, Substance Use), divided by the total amount of variance in Y , and explained by both M and X . The R^2 proportion was calculated, and it produced an effect size of .34, indicating a moderate effect of Social Network Quality on School Problems' influence on Substance Use.

Discussion

Very few studies have analyzed urban adolescents' social network quality in detail (e.g., substance users, daily users, influence to use substances, and protective and risky activities) to examine school problems' association with substance use. The present results suggest that for these urban adolescents, social network quality partially mediates the effects of school problems on substance use while accounting for internalizing problems and relations with parents. Unique to social network studies was the use of the salient and multidimensional construct School Problems. Because this measure accounted for broad patterns of dissatisfaction with school, personnel, and the structure of the educational processes as well as for sensation seeking, it provided the theoretical linkage between the school setting, social network quality, and substance use. Thus, the present findings support the social hypothesis that the negative influence of school problems on substance use can be partially mediated by protective social networks. In this study, the mediated effect of social network quality explains 34% of the total effect of school problems' influence on substance use.

The finding concluded by the multigroup analysis contradicted the hypothesis of group differences by gender and age, indicating no significant difference between these groups. One explanation is that school problems cut fairly evenly across groups, which was supported by the initial chi-square analysis that found no difference of school problems by gender and age. The partial mediation effect of social network quality on school problems appears to be equal among the four groups, indicating the robust protective nature of social networks across group differences.

In examining the final full-sample model, it is noted that five of the six pathways were highly significant ($p < .01$), with only Relations with Parents to School Problems being non-significant ($p = .09$). Regarding the two exogenous variables, a strong negative coefficient ($-.33$) between Internalizing Problems and Relations with Parents supports our theoretical assumption of the bi-directional influence of these variables. Internalizing Problems is strongly related to School Problems (.45), which in this model is interpreted as causal influence on School Problems. The mediation pathway from School Problems to Social Network Quality is negative and fairly strong ($-.23$), with increases in School Problems reducing Social Network Quality or increasing Network Risk. The pathway from Social Network Quality to Substance Use demonstrates very strong protective effects ($-.58$), with Substance Use decreasing for every increase in Network Quality. The direct effect of School Problems on Substance Use was fairly small (.14) but significant. In imagining this effect in a prevention practitioner context, if one's target population began increasing their substance use by 14%, a practitioner would be concerned and would focus on the cause of the increase (e.g., school problems) for an intervention. Likewise, if a practitioner found a way to leverage the natural mediating effect of Social Network Quality on Substance Use, knowing that it accounts for 34% of the total effect of School Problems' influence on Substance Use, this would be very strong prevention starting point. A social-network-based intervention would be well founded based upon these data. It is not unreasonable to assume that providing a brief network-based intervention could activate that natural protective quality of adolescent networks, reducing social stress, which further protects against substance use. In fact, a preliminary clinical trial has recently found this effect a similar sample (Mason et al. 2010).

Several limitations should be considered when interpreting the findings from this study. First, the study design was cross-sectional and therefore cannot fully test the causal hypothesis that was advanced. In particular, when examining adolescents, being able to estimate the duration and malleability of these findings across developmental periods would be beneficial. Though our model is supported by the literature and the current study's

empirical findings, it is acknowledged that the sequencing of some variables could be considered differently (e.g., internalizing problems could be the result rather the cause of school problems). However, the variable sequencing and theoretical explanation makes logical sense, is supported by the overall strength of the model, and provides a strong foundation in which to test future longitudinal models. Second, the assessment, though extensive in many regards, did not capture family and school issues as thoroughly as possible. Only one scale that focused on parent–adolescent relations from the adolescents' perspective was used. Clearly, understanding more of the family history and functioning would have added another important dimension to these data. Furthermore, having more objective school data such as test scores and GPA and behavioral data such as truancy would help to add depth to the School Problems composite. Third, the design was limited by collecting data only from the adolescent and not including parents, peers, and teachers. Finally, the sample was essentially homogenous by race and SES, with the sample being drawn from a low-resource, African American urban community. Larger longitudinal studies with different samples of adolescents (e.g., non-urban) and settings would be additive to this line of study. Generalizability from these findings should be limited to similar groups.

Despite these limitations, the results add to the literature of the mediating effects of social networks on school problems and the associated risk of substance use. These findings suggest that social network research provides a useful social ecological approach toward addressing urban adolescent substance use. This study may specifically provide guidance for preventive research that targets particular groups of adolescents (e.g., those who are struggling in school) with social-network-infused intervention models.

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References

- Alexander C, Piazza M, Mekos D, Valente TW. Peer networks and adolescent cigarette smoking: An analysis of the national longitudinal study of adolescent health. *Journal of School Health* 2001;29(1):22–30.
- Bandura A. The primacy of self-regulation in health promotion. *Applied Psychology: An International Review* 2005;54(2):245–254.
- Bauman K, Ennett S. On the importance of peer influence for adolescent drug use: Commonly neglected considerations. *Addictions* 1996;91(2):185–198.
- Blunch, N. Introduction to structural equation modeling using SPSS and AMOS. Los Angeles, CA: Sage Press; 2008.
- Brewer DD. Forgetting in the recall-based elicitation of personal and social networks. *Social Networks* 2000;22(1):29–43.
- Bronfenbrenner, U. The ecology of human development: Experiments by nature and design. Cambridge, MA: Harvard University Press; 1979.
- Burt RS. Network items and the general social survey. *Social Networks* 1984;6(4):293–339.
- Burt, RS. Structural holes: The social structure of competition. Cambridge, MA: Harvard University Press; 1992.
- Byrne BM. Testing for multigroup invariance using AMOS graphics: A road less traveled. *Structural Equation Modeling: A Multidisciplinary Journal* 2004;11(2):272–300.

- Costello EJ, Erkanli A, Federman E. Development of psychiatric comorbidity with substance abuse in adolescents: Effect of timing and sex. *Journal of Clinical Child Psychology* 1999;28(3):298–311. [PubMed: 10446679]
- Costello EJ, Erkanli A, Fairbank JA, Angold A. The prevalence of potentially traumatic events in childhood and adolescence. *Journal of Traumatic Stress* 2002;15(2):99–112. [PubMed: 12013070]
- Cotterell, J. *Social networks in youth & adolescents*. London, UK: Routledge; 2007.
- Curran PJ, Stice E, Chassin L. The relation between adolescent alcohol use and peer alcohol use: A longitudinal random coefficients model. *Journal of Consulting and Clinical Psychology* 1997;65(1):130–140. [PubMed: 9103742]
- Friedmann PD, Zhang Z, Hendrickson J, Stein MD, Gerstein DR. Effect of primary medical care on addiction and medical severity in substance abuse treatment programs. *Journal of General Internal Medicine* 2003;18(1):1–8. [PubMed: 12534757]
- Grella C, Hser Y, Joshi V, Rounds-Bryant J. Drug treatment outcomes for adolescents with comorbid mental and substance use disorders. *Journal of Nervous and Mental Diseases* 2001;189(6):384–392.
- Hawkins D, Catalano R, Miller J. Risk and protective factors for alcohol and other drug problems in adolescence and early adulthood: Implications for substance abuse prevention. *Psychological Bulletin* 1992;112(1):64–105. [PubMed: 1529040]
- Hu L, Bentler PM. Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling* 1999;6(1):1–55.
- Hussong AM. Differentiating peer contexts and risk for adolescent substance use. *Journal of Youth and Adolescence* 2002;31(3):207–220.
- Ialongo N, Poduska J, Werthamer L, Kellam S. The distal impact of two first grade preventive interventions on conduct problems and disorder in early adolescence. *Journal of Emotional and Behavioral Disorders* 2001;9(2):146–160.
- Kandel DB, Johnson JG, Bird HR, Weissman MM, Goodman SH, Lahey BB, et al. Psychiatric comorbidity among adolescents with substance use disorders: Findings from the MECA study. *Journal of the American Academy of Child and Adolescent General Psychiatry* 1999;57(6):261–269.
- Kilpatrick DG, Acierno R, Saunders B, Resnick HS, Best CL, Schurr PP. Risk factors for adolescent substance abuse and dependence: Data from a national sample. *Journal of Consulting and Clinical Psychology* 2000;68(1):1–12.
- Kirke, DM. *Teenagers and substance use: social networks and peer influence*. London, UK: Kluwer; 2006.
- Liebow E, McGrady G, Branch K, Vera M, Klov Dahl A, Lovely R, et al. Eliciting social network data and ecological model-building: Focus on choice of name generators and administration of random-walk study procedures. *Social Networks* 1995;17(3–4):257–272.
- Lubitz, R. Diagnosis and treatment of trauma in children. In: Cheng, K.; Myers, K., editors. *Child and adolescent psychiatry: The essentials*. Philadelphia, PA: Lippincott Williams & Wilkins; 2005. p. 341–362.
- Mackinnon, DP. *Introduction to Statistical Mediation Analysis*. New York, NY: Lawrence Erlbaum; 2008.
- Marsden PV. Network data and measurement. *Annual Review of Sociology* 1990;16:435–463.
- Mason MJ. Social network characteristics of urban adolescents in brief substance abuse treatment. *Journal of Child and Adolescent Substance Abuse* 2009;18(1):72–84.
- Mason M, Cheung I, Walker L. Substance use, social networks and the geography of urban adolescents. *Substance Use and Misuse* 2004;39(10–12):1751–1778. [PubMed: 15587950]
- Mason, MJ.; Pate, P.; Drapkin, M.; Sozinho, K. Motivational interviewing integrated with a social network intervention for urban female adolescents in primary care. Paper presented at the International Conference on Motivational Interviewing; Stockholm, Sweden. 2010.
- Mason M, Valente T, Coatsworth JD, Mennis J, Lawrence F, Zelenak P. Place-based social network quality and correlates of substance use among urban adolescents. *Journal of Adolescence* 2010b; 33(3):419–427. [PubMed: 19665785]

- Masten AS, Coatsworth JD, Neeman J, Gest SD, Tellegen A, Gramezy N. The structure and coherence of competence from childhood through adolescence. *Child Development* 1995;66(6):1635–1659. [PubMed: 8556890]
- Mayes, L.; Suchman, N. Developmental pathways to substance abuse. In: Cicchetti, D.; Cohen, DJ., editors. *Developmental psychopathology. Risk, disorder, & adaptation*. Vol. 3. Hoboken, NJ: Wiley & Sons; 2006. p. 599-619.
- Moberg DP, Hahn L. The adolescent drug involvement scale. *Journal of Adolescent Chemical Dependency* 1991;2(1):75–88.
- O'Donnell DA, Schwab-Stone ME, Mueeed AZ. Multidimensional resilience in urban children exposed to community violence. *Child Development* 2002;73(4):1265–1282. [PubMed: 12146747]
- Reynolds, C.; Kamphaus, R. *Behavior Assessment System for Children*. 2. Bloomington, MN: Pearson Assessments; 2004.
- Saitz R, Horton NJ, Larson MJ, Winter M, Samet JH. Primary medical care and reductions in addiction severity: A prospective cohort study. *Addiction* 2005;100(1):70–78. [PubMed: 15598194]
- Substance Abuse and Mental Health Services Administration. Results from the 2006 National Survey on Drug Use and Health: National Findings (NSDUH Series H-28, DHHS Publication NO. SMA 05–4062). Rockville, MD: Office of Applied Studies; 2007.
- Substance Abuse Mental Health Services Administration. Results from the 2008 National Survey on Drug Use and Health: National Findings (Office of Applied Studies, NSDUH Series H-36, HHS Publication No. SMA 09–4434). Rockville, MD: Office of Applied Studies; 2009.
- Unger JB, Chen X. The role of social networks and media receptivity in predicting age of smoking initiation: A proportional hazards model of risk and protective factors. *Addictive Behaviors* 1999;24(3):371–381. [PubMed: 10400276]
- Urberg KA, Luo Q, Pilgrim C, Degirmencioglu SM. A two-stage model of peer influence in adolescent substance use: Individual and relationship-specific differences in susceptibility to influence. *Addictive Behaviors* 2003;28(7):1243–1256. [PubMed: 12915166]
- Valente T. Social networks' influence on adolescent substance use: An introduction. *Connections* 2003;25(2):11–16.
- Valente TW, Watkins S, Jato MN, Van der Straten A, Tsitsol LM. Social network associations with contraceptive use among Cameroonian women in voluntary associations. *Social Science and Medicine* 1997;45(5):677–687. [PubMed: 9226791]
- Valente T, Unger J, Johnson A. Do popular students smoke? The association between popularity and smoking among middle school students. *Journal of Adolescent Health* 2005;37(5):323–329. [PubMed: 16182143]
- Vandenberg RJ, Lance CE. A review and synthesis of the measurement invariance literature: Suggestions, practices, and recommendations for organizational research. *Organizational Research Methods* 2000;3(1):4–69.
- Vehovar V, Manfreda K, Koren G, Hlebec V. Measuring ego-centered social networks on the web: Questionnaire design issues. *Social Networks* 2008;30(3):213–222.
- Wills TA, Cleary SD. Peer and adolescent substance use among 6th–9th graders: Latent growth analyses of influence versus selection mechanisms. *Health Psychology* 1999;19(5):453–463. [PubMed: 10519461]
- Wills TA, Sandy JM, Yaeger AM, Cleary SD, Shinar O. Coping dimensions, life stress, and adolescent substance use: A latent growth analysis. *Journal of Abnormal Psychology* 2001;110(2):309–323. [PubMed: 11358025]
- Wills TA, Sandy JM, Yaeger AM. Stress and smoking in adolescence: A test of directional hypotheses. *Health Psychology* 2002;21(2):122–130. [PubMed: 11950102]
- Windle M. A longitudinal study of antisocial behaviors in early adolescence as predictors of late adolescent substance use: Gender and ethnic group differences. *Journal of Abnormal Psychology* 1990;99(1):86–91. [PubMed: 2307771]
- Winters, KC. Screening and assessing youth for drug involvement. In: Columbus, JAM., editor. *Assessing alcohol problems: A guide for clinicians and researchers*. 2. Rockville, MD: National Institute on Alcohol; 2003. p. 101-124.

World Health Organization Europe. World Health Organization Collaboration Project on Identification and Management of Alcohol. Related Problems in Primary Health Care: Phase IV. 2001. Retrieved May 16, 2010 from <http://www.who-alcohol-phaseiv.net>

Zahn-Waxler, C.; Crick, N.; Shirtcliff, E.; Woods, K. The origins and development of psychopathology in females and males. In: Cicchetti, D.; Cohen, DJ., editors. Developmental psychopathology. Theory & method. Vol. 1. Hoboken, NJ: Wiley & Sons; 2006. p. 76-138.

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Fig. 2.
Path model predicting substance use ($N = 301$). $*p < .01$

Table 1Participant and resident neighborhood characteristics ($N = 301$)

Participant characteristics	Count	%
Age ^a		
13–15	105	35
16–18	116	39
19–20	80	26
Gender		
Male	118	39
Female	183	61
Race		
African American	262	87
Mixed Race	24	8
Other	15	5

Resident neighborhood characteristics	% (block group or density)
Below poverty line (block group)	32 (21)
Adult drug possession arrest (density)	67 per km ² (46 per km ²)
Vacant housing rate (block group)	15 (10)

^a $M(SD) = 17(2)$

Table 2

Intercorrelations among variables in models, controlling for gender and age

Variable	Substance use	Social network quality	School problems	Internalizing problems	Relations with parents
Substance use	—				
Social network quality	-.490 ***	—			
School problems	.233 ***	-.188 **	—		
Internalizing problems	.062	-.040	.454 ***	—	
Relations with parents	-.143 *	.056	-.240 ***	-.342 ***	—

* $p < .05$;

** $p < .005$;

*** $p < .001$