Teen Social Networks and Depressive Symptoms-Substance Use Associations: Developmental and Demographic Variation

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ABSTRACT. Objective: The current study examined whether an adolescent's standing within a school-bounded social network moderated the association between depressive symptoms and substance use across adolescence as a function of developmental and demographic factors (gender, parental education, and race/ethnicity). Method: The sample of 6,776 adolescents participated in up to seven waves of data collection spanning 6th to 12th grade. Results: Results of latent growth models showed that lower integration into the social network exacerbates risk for depression-related substance use in youth, particularly around the high school transition, but social status acted as both a risk factor and a protective factor at different points in development for different youth. Findings also varied as a function of youth gender and parental education status. Conclusions: Together these findings suggest that lower integration into the social network exacerbates risk for depression-related substance use in youth, particularly around the high school transition in general as well as just before the high school transition in those with lower parental education or just after the high school transition in males. Thus, the risky impact of social isolation appears more consistent across this period. Social status, however, showed a more varied pattern and further study is needed to understand the sometimes risky and sometimes protective effects of social status on depression-related substance use. (J. Stud. Alcohol Drugs, 79, 770–780, 2018)

ADOLESCENT SUBSTANCE USE is ubiquitous, and greater use is associated with the three leading causes of death in adolescence (i.e., suicide, homicide, and accidents; Heron, 2016) as well as with delinquent and criminal activity, poor school performance and retention, early and unplanned pregnancy, and mental health problems (Chassin et al., 2009). Developmental models place the widespread substance use behaviors of adolescents in the context of the life course (Masten et al., 2008). Such models identify mechanisms that emerge over development and lead to substance use; as a result, they are powerful informants for prevention efforts regarding when intervention should occur, who should receive intervention, and what factors should be altered by intervention (Ialongo et al., 2006). In the current study, we build on work that integrates two developmental models: the internalizing pathway to substance use and disorder (Hussong et al., 2011) and a social network model of adolescent substance use (Ennett et al., 2006).

The internalizing pathway to substance use and disorder posits that substance use develops for some as a form of emotion regulation (i.e., how individuals monitor, evaluate, and modify their emotional reactions in service of meeting their goals; Hussong et al., 2011). Unlike self-medication and strain theories, the internalizing pathway is based on developmental theory. This framework focuses on how distress-motivated substance use emerges across development, with origins in early life before use onset, and how this use is embedded in individual and social contexts relevant to each developmental period. Consistent with predictions of the internalizing pathway, a recent review of more than 60 previous studies showed that depressive symptoms are more consistently associated with future substance use outcomes than are either anxiety or overall internalizing symptoms,

when controlling for comorbid externalizing symptoms (Hussong et al., 2017a). However, depressive symptoms themselves remain an inconsistent predictor of adolescent substance use.

Several factors may account for this inconsistency and thus serve as moderators of the association between depressive symptoms and substance use during adolescence. Notably, adolescent substance use largely occurs within the peer context, and factors associated with an adolescent's standing within the peer context may constitute important moderating factors. The social network model posits that two attributes of social standing measured in social networks are expected to influence adolescent substance use (Ennett et al., 2006). They are social integration (i.e., the extent to which adolescents are embedded in larger social networks) and social status (i.e., popularity and recognition from peers). Previous studies show that youth who are not well integrated into social relationships are at heightened risk for substance use (Ennett & Bauman, 1993; Ennett et al., 2006; Shadur & Hussong, 2014). Similarly, adolescents lower in social status among their peers may use substances as a means of gaining social status (Allen et al., 2005; Balsa et al., 2011; Crosnoe & Needham, 2004; Diego et al., 2003; Ennett et al., 2006; Killeya-Jones & Miller-Johnson, 2007; Mayeux et al., 2008; Osgood et al., 2014; Vogel et al., 2015). As we test in this study, differences in these social network associations with substance use may vary across youth as a function of depressive symptoms or demographic factors and development.

More specifically, we posit that risk for substance use as a means of alleviating distress may be exacerbated for youth with low social integration or status. These two indicators of low social standing may increase youth's distress and create a motivation to use substances (i.e., to relieve distress). Because socially marginalized youth often use substances more frequently than their peers, they may also have greater access to and support for using substances (Hussong et al., 2011). Thus, coping motives and access to substances may jointly heighten risk for substance use in depressed youth with low social integration or status. Previous cross-sectional studies have shown that the association between depressive symptoms and substance use is stronger for youth in less supportive friendships (Hussong & Hicks, 2003) and for youth who participate less in their social networks (i.e., have less structural social capital; Awgu et al., 2016). Daily diary and experience sampling studies show the same finding in college students (Hussong et al., 2001) although not in youth before the transition to high school (Shadur & Hussong, 2014). Moreover, recent longitudinal work revealed that depressive symptoms in grade 7 predicted significant increased alcohol intoxication among low-accepted youth, but not average-accepted or high-accepted youth, from grades 7 to 9 (Richmond et al., 2015). No studies, however, have directly tested whether indicators of social standing moderate the association between depressive symptoms and substance use

across adolescence. Given posited factors that may change social integration and social status over the course of adolescence, we anticipate that the moderating roles of social integration and status may be particularly relevant as youth move from middle to high school, a time of social reorganization and, for some, school-related stress (Gottfredson & Hussong, 2011).

We also expect individual differences to alter risk for substance use among youth with depressive symptoms and low social integration or status. One source of individual differences may be demographic indicators that are associated with risk for substance use more generally. A cumulative risk model would suggest that youth with multiple risk factors will experience greater risk for substance use, perhaps beyond the additive effects of the risk factors when occurring individually (Sampson & Laub, 1997). As such, depressive symptoms and low social standing may better predict substance use for boys than for girls, for White and Latino youth than for African American youth, and for youth from families with a higher and lower (vs. mid-range) socioeconomic status (Patrick & O'Malley, 2015).

In the current study, we test whether associations among social standing, depressive symptoms, and substance use vary across adolescence. We posit that depressive symptoms and social standing early in adolescence may interact to predict escalating trajectories of substance use over time. We also anticipate that within-person elevations in social standing and depressive symptoms may be proximal markers of risk for time-specific substance use. For this reason, we differentiate time-varying effects posited by this moderation hypothesis (which differentiate the developmental period during which a mechanism is likely to occur) and time-invariant effects (that differentiate who is at risk for escalating patterns of substance use over time). Specifically, we posit that (Hypothesis 1) time-invariant effects of depressive symptoms and poor social standing (as indexed by both integration and status) will interact to predict escalating trajectories of substance use across adolescence, even after controlling for comorbid externalizing symptoms; (Hypothesis 2) time-specific elevations in depressive symptoms will interact with time-specific social integration and status to predict time-specific elevations in substance use; (Hypothesis 3) these moderating effects will be stronger for youth who are also at risk for substance use on the basis of individual differences with elevated risks for boys, White and Latino youth, and privileged as well as disadvantaged youth (compared with middle-class youth); and (Hypothesis 4) these posited associations will be most evident during vulnerable periods surrounding the high school transition.

Method

The Context Study used a cohort-sequential design in which three cohorts of adolescents in the sixth, seventh, and

eighth grades from three complete school districts in three primarily rural North Carolina counties were surveyed every 6 months for five data collection waves. Adolescents in two of the three school districts were surveyed in two additional waves, 6 and 12 months later.

Participants

At Wave 1, adolescents were enrolled in all 10 middle schools (grades 6, 7, 8) that fed into six high schools in the three study school districts (alternative schools were excluded). Beginning with Wave 2, when the first adolescents transitioned to high schools, the school sample added all six high schools in the districts. The school sample size fluctuates across waves depending on the inclusion of middle and high schools and due to a single school system not participating at Waves 6 and 7 (because of a change in administration). At each wave, all enrolled students at the targeted grade levels, except for those in self-contained classrooms for exceptional children and those with limited English language reading skills, were eligible for the study. The sample includes 6,776 adolescents who participated in at least one of the seven waves of data collection. At Wave 1, the mean age of adolescents was 13.09 years ($SD = 1.00$). About half were male (52%); 53% were White, 37% Black, 4% Hispanic, and 6% other race/ethnicity. A little over 10% of adolescents lived with a single parent, and for 33% of adolescents the highest education attained by either parent was a high school education or less. Participation rates were relatively high, with 88%, 81%, 81%, 79%, 76%, 75%, and 73% of eligible students responding to the survey at Waves 1–7, respectively.

Procedures

At each of the seven waves, adolescents completed in-school self-administered questionnaires taking approximately 1 hour. Trained data collectors provided instructions and monitored data collection. To minimize response bias, teachers were instructed not to answer questions about the study or walk around the classroom, but to stay in the classroom to maintain order. Adolescents were spread out from each other and instructed to use the questionnaire envelope to cover their answers. Adolescents' parents received letters that included telephone and mailed procedures for refusing study participation by their child. Written assent was obtained in school from adolescents. These procedures were approved by the University of North Carolina at Chapel Hill Institutional Review Board.

Measures

Measures included adolescent-reported demographics (gender, race/ethnicity, highest parental education level, and grade in school). Race indicators included Black and White/

Latino. (Given similarity in substance use rates and few Latinos in the sample, we combined the White and Latino groups for analysis).

The substance use indicator included items assessing alcohol consumption (i.e., quantity of use and frequency of use, having 3–4 drinks in a row, having 5 or more drinks, getting drunk, getting drunk while alone, and being hungover in past 3 months) and related consequences (five items from Bearman et al., 1997); one item assessing frequency of marijuana use in the past 3 months; and two items assessing quantity and frequency of tobacco use in the past 3 months and seven tobacco-related consequence items (Heatherton et al., 1991). To assess depressive symptoms, adolescents completed three items from the Short Mood and Feelings Questionnaire (Angold et al., 1995) using a 5-point response scale. Deviance in the past 6 months, an indicator of comorbid externalizing symptoms, was measured by 15 items from the Problem Behavior Frequency Scale (Farrell et al., 2000). Rates of past-3-month tobacco, marijuana, and alcohol use are shown in Table 2.

Social integration and social status measures were derived from social network analyses (Cole et al., 2017; Ennett et al., 2006). Social network analyses were based on friendship nominations made by adolescents within their social network. Adolescents identified up to five of their closest friends using standard nomination procedures. Each adolescent was associated with a peer social network at each data collection wave, with networks bounded by school and, in middle school, by grade; schools form natural boundaries for adolescent friendships because they are the primary setting in which adolescents interact with each other. Because of school mergers at the transition to high school, middle school networks merged into larger high school networks. Each social network was analyzed at each data collection wave to form the social network measures. To obtain social network measures, we conducted the social network analysis using standard graph-based algorithms (Borgatti et al., 2002; Moody, 2001). From these analyses, we derived indicators of social integration and social status (Table 1).

Analytic plan

As in our previous work, we used moderated nonlinear factor analysis (MNLFA; Curran et al., 2016) to create factor score estimates for each of our constructs (see Cole et al., 2017, for details). An extension of factor analysis and item response theory, MNLFA generates scores that reflect not simply how many items were endorsed but which pattern of items were endorsed. Additionally, MNLFA allows student characteristics to directly affect both the mean and variance of the latent variable, referred to as impact, as well as measurement parameters linking items to the latent variable, referred to as differential item functioning. Descriptive statistics for factor scores are shown in Table 2.

TABLE 1. Social network measures derived from social network analysis

Measure	Definition	M (SD)
Social integration		
Outdegree	Number of up to 5 in-school friendship nominations	3.48 (1.63)
Reciprocity	Proportion of friendship nominations reciprocated by other	1.53 (1.39)
Transitivity	Proportion of triads where other's friend is a friend of the target	1.92 (2.33)
Intransitivity	Number of triads where transitivity does not occur	20.27 (15.34)
Out of network friends	Number of out-of-school friendship nominations	0.94 (1.24)
Social status		
Indegree	Number of in-school peers in the network who nominate target	3.06 (2.47)
Bonacich centrality	Weighted composite indicating greater tendency to have popular friends	1.08 (1.6)
Betweenness centrality	Weighted composite indicating frequency of targets' direct inclusion in close friendships	0.98 (0.52)
Three-step in-reach	Weighted composite indicating tendency to be in close social distance to others	6.84 (8.35)

TABLE 2. Percentage of students reporting tobacco, marijuana, and alcohol use in the past 3 months

	Percentage of students using each substance		
	Tobacco	Marijuana	Alcohol
Spring 6	8.42	3.14	8.21
Fall 7	12.41	5.25	11.41
Spring 7	15.37	8.20	14.97
Fall 8	19.21	12.30	19.75
Spring 8	20.00	14.17	22.90
Fall 9	26.30	19.72	29.76
Spring 9	26.38	21.58	32.40
Fall 10	26.66	22.89	34.70
Spring 10	27.87	25.22	44.47
Fall 11	27.72	26.43	39.79
Fall 12	25.33	25.24	46.18

We tested hypotheses through a series of latent growth models. These models included time-invariant predictors for depressive symptoms, social network indicators, deviance, parental education level, ethnicity, and gender as well as time-varying predictors for depressive symptoms and social network indicators all predicting adolescent substance use. Two models tested Hypothesis 1 by including interactions between time-invariant social network indicators and depressive symptoms (defined as the person-level mean of each) predicting adolescent substance use trajectories (one model for social integration and social status, respectively). Two models tested Hypothesis 2 by including interactions between each time-varying social network indicator and depressive symptoms predicting time-specific elevations in adolescent substance use. Two models tested Hypothesis 3 by including three-way interaction terms among time-varying depressive symptoms, each time-varying social network indicator, and each demographic indicator as well as all contributing two-way interactions (Figure 1). Models testing Hypothesis 2 and 3 contained tests of time-specific associations relevant to testing Hypothesis 4. In models with time-varying values of social integration, social status, and depressive symptoms, these values were centered around each participant's mean.

As reported elsewhere (Hussong et al., 2017b), we modeled growth for substance use MNFLA scores using a linear-linear piecewise model with a knot at the Grade 8 Spring assessment fit to the expectation maximization means (Enders & Peugh, 2004). We corrected for growth in each social network variable using autoregressive paths constrained in magnitude to follow the estimated trajectory for that social network indicator as found in separate latent basis models for each indicator (Hussong et al., 2017b). This allowed time-varying covariate growth to be modeled while also estimating as few parameters as possible. All models were estimated in Mplus 7.4 with Bayesian Markov chain Monte Carlo. Each model has many predictors, which raised concerns about familywise error rates; Bayes operates without null hypotheses and this issue is handled internally by the estimation process (Gelman et al., 2012). Bayesian analysis is not conducive to discussing effects in terms of significance; instead the presence of 0 in the 95% credible interval (CI) is inspected to determine if effects are non-null (similar to confidence intervals in frequentist analyses).

Results

Hypothesis 1: Time-invariant depressive symptoms and social network characteristics interact to predict escalating substance use trajectories

To determine the shape of growth, we first fit an unconditional piecewise linear model. This model was characterized by an intercept ($M = -.049$, 95% CI = [-.075, -.020]; variance = .212, 95% CI = [.195,.231]), a larger positive linear slope before high school ($M = .468$, 95% CI = [.458, .475]; variance = .022, 95% CI = [.020, .023]), and a smaller positive slope after high school ($M = .140$, 95% CI = [.133, .147]; variance = .013, 95% CI = [.012, .015]). Thus, substance use appears to increase rapidly through middle school, before leveling off in high school. Importantly, the large variance in the intercept term indicates that there is great heterogeneity in overall levels of substance use among students.

Both time-invariant interactions of the social network variables (social integration and social status) with depressive symptoms were non-null only when predicting the slope

TABLE 3. Standardized effect sizes: Time-invariant interactions predicting adolescent substance use trajectories

Predictors	Estimates predicting growth trajectory outcomes		
	Intercept	MS slope	HS slope
Black	**.096**	**-.398**	**-.311**
Male	**-.385**	.014	**.084**
Low parental education	**.216**	.004	-.019
High parental education	-.053	-.039	-.027
Deviance	**.290**	**.447**	-.001
Depression	**.142**	.054	-.037
Social status	**.076**	-.046	**.075**
Social integration	-.041	.001	**.105**
Social Status × Depression	.043	-.012	**-.090**
Social Integration × Depression	-.008	.020	**-.083**

Notes: The Social Integration model and Social Status model were run separately. Because the outcome was the same in each model, time-invariant depression was common to both models and estimates were the same to the third decimal point. To conserve space, both models are combined into one table, but the Social Status estimates are not conditional on Social Integration and vice versa. **Bold** values indicate the effect was considered non-null based on a 95% interval. MS = middle school; HS = high school.

of substance use in high school (Table 3). The full social status model accounted for 41.7%, 37.7%, and 12.9%, and the full social integration model accounted for 42.0%, 37.2%, and 13.0% of the variance in substance use intercepts, middle school slopes, and high school slopes, respectively. The negative interactions showed that higher depressive symptoms predicted faster growth in high school substance use among those lower in social status or integration. The correlation between time-invariant indicators of social status and integration was $r = .72$.

Hypothesis 2: Time-varying fluctuations in depressive symptoms and social networks predict time-specific fluctuations in substance use

Time-varying depressive symptoms were non-null predictors at nearly every time point, indicating that students with higher depressive symptoms had higher time-specific elevations in substance use. The full model accounted for 35.4%–88.8% of the variance in time-varying substance use outcomes (i.e., deviations in substance use for an individual relative to his or her substance use trajectory) across time points for social status models and 35.4%–88.6% for social integration models. Time-varying effects of the social network variables tended to be non-null near the transition to high school (grade 8 to grade 10); lower levels of social status tended to predict greater substance use at these times, as did lower social integration. The time-varying moderation effects of social integration and status on depressive symptoms-use associations differed in sign and were only present following the high school transition (Table 4). Depressive symptoms were more strongly associated with time-specific elevations in substance use for those with higher social status (fall and spring of ninth grade) and for those with lower social integration (spring of ninth grade). The correlation between time-varying indicators of social status and integration ranged from .28 to .68 over grade.

Hypothesis 3: Time-varying interactive effects of social network and depressive symptoms are moderated by demographic characteristics

Although race differences were null, gender and parental education were non-null moderators of the interactions between social network indicators and depressive symptoms predicting time-specific elevations in substance use. Non-null gender differences were found in grade 10 only as evident by Depressive Symptoms × Social Status × Gender (standardized effect = -0.03, 95% CI = [-.05, -.00]; fall of 10th grade) and Depressive Symptoms × Social Integration × Gender effects (standardized effect = 0.04, 95% CI = [.01, .08]; spring of 10th grade) on substance use. Effects were similar across social indices (Figure 2). For high-status and

TABLE 4. Standardized effect sizes: Time-varying interactions predicting time-specific elevations in adolescent substance use

Time	Depressive symptoms	Social status	Social integration	Social Status × Depressive Symptoms	Social Integration × Depressive Symptoms
6S	**.109**	-.019	**-.042**	-.014	-.001
7F	.011	**.042**	**.043**	.002	.023
7S	**.063**	-.012	.004	.011	.005
8F	**.026**	-.002	.003	.026	.013
8S	**.024**	-.006	.008	-.007	.007
9F	**.036**	-.023	.003	**.026**	.020
9S	**.066**	**-.033**	**-.026**	**.028**	**-.034**
10F	**.063**	**-.020**	-.020	-.014	.002
10S	**.040**	-.026	**-.047**	-.002	.018
11F	**.046**	.004	.005	-.016	-.013
12F	**.061**	**.072**	**.054**	.005	.024

Notes: The Social Integration model and Social Status model were run separately. Because the outcome was the same in each model, time-varying depressive symptoms were common to both models and estimates were the same to the third decimal point. To conserve space, both models are combined into one table, but the Social Status estimates are not conditional on Social Integration and vice versa. **Bold** values indicate the effect was considered non-null based on a 95% interval. Time denotes grade (6–12) and semester (S = spring; F = fall) of assessment.
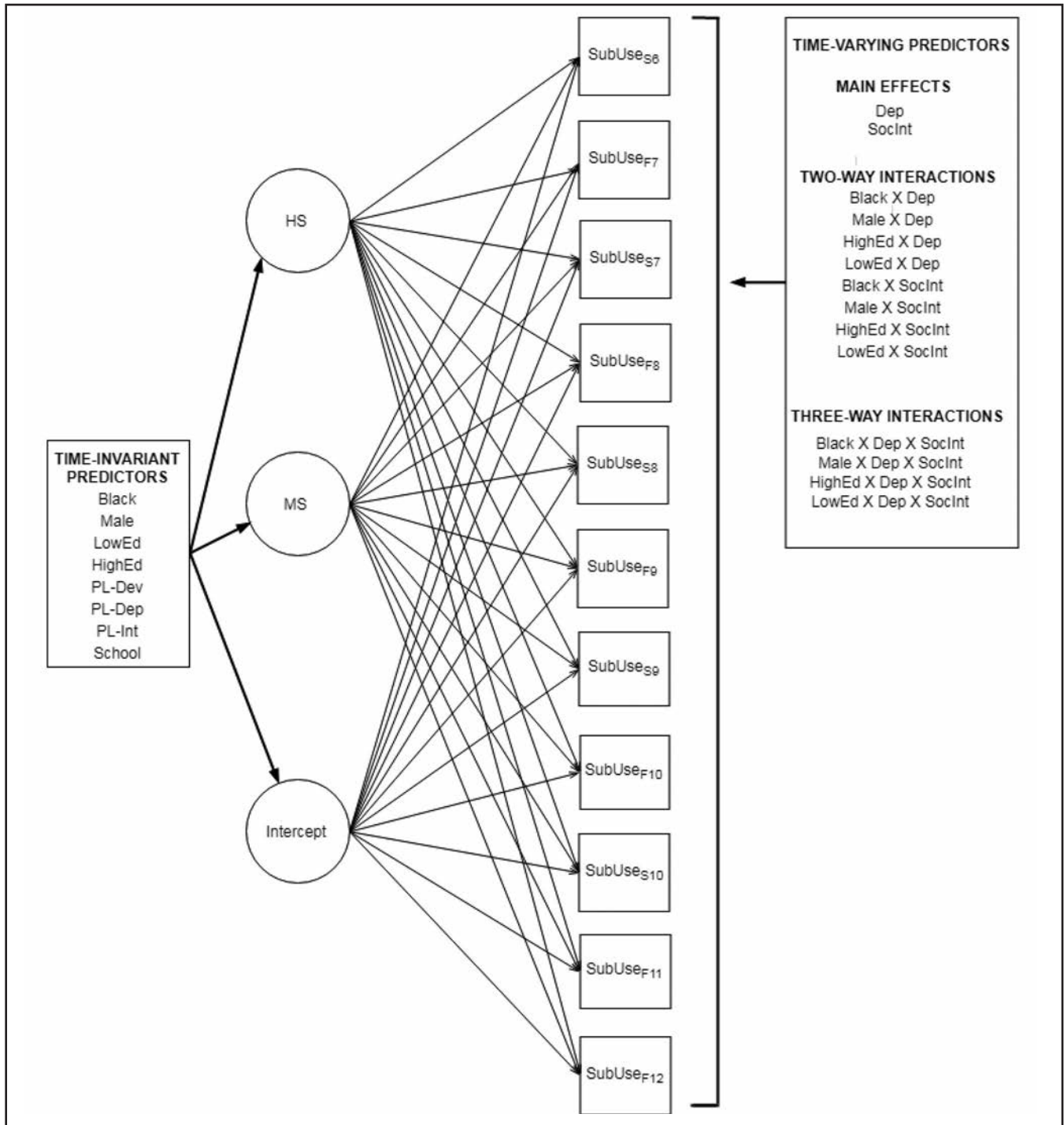
FIGURE 1.   Proposed model. HS = high school; MS = middle school; SubUse = substance use; Ed = education; Dep = depressive symptoms; Dev = deviance; SocInt = social integration; PL = person level.

well-integrated girls, depressive symptoms increased risk for substance use to a level like that of other girls (for whom depressive symptoms made little difference in risk for use). For boys, depressive symptoms social status had little effect on risk for depression. However, depressive symptoms were a protective factor against use for boys who were poorly integrated into their social networks.

Non-null effects for parental education were found just before and after the high school transition as evident by Depressive Symptoms × Social Integration × Parental
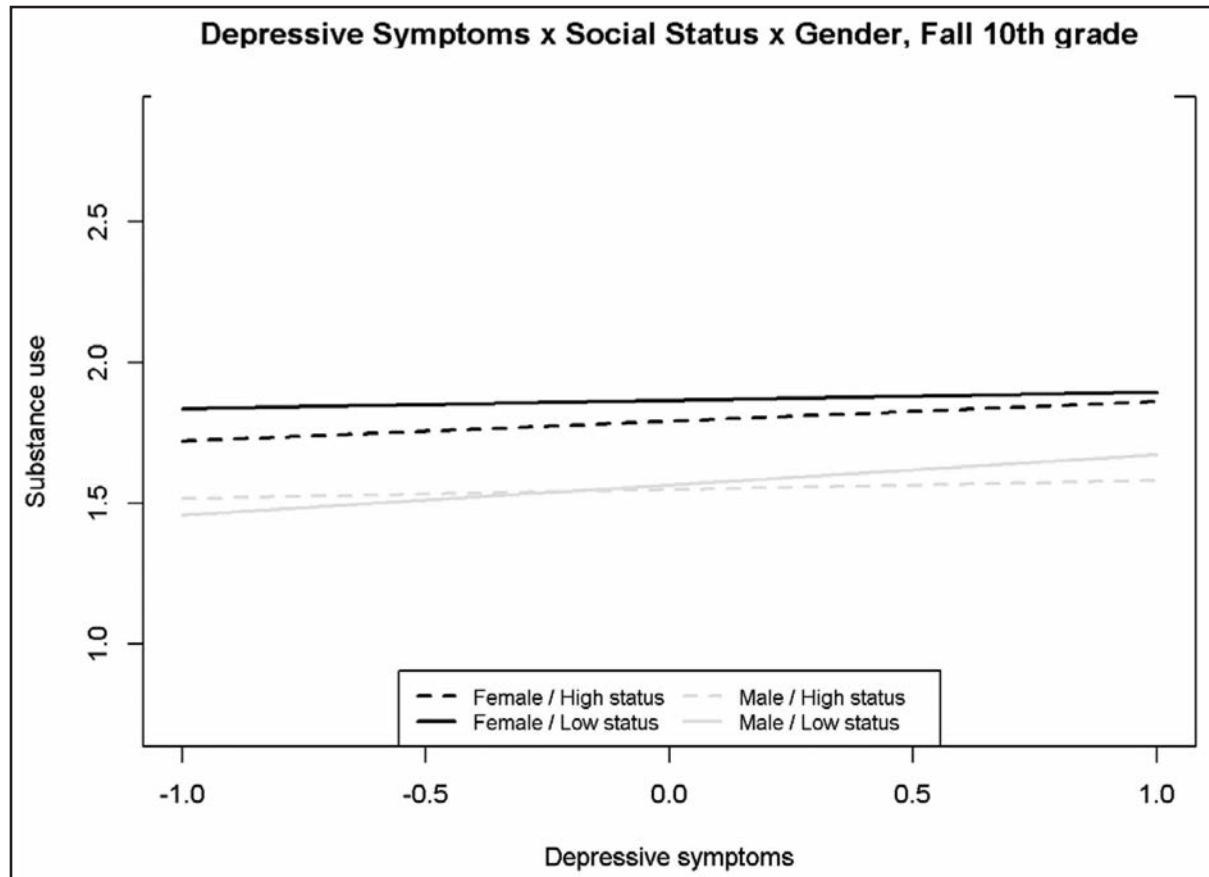
FIGURE 2.   Three-way interaction between depressive symptoms, social status, and gender predicting time-varying substance use in the fall of 10th grade. *Note:* High status indicates high social status and low status indicates low social status.

Education effects on time-specific elevations in substance use (spring 7th grade standardized effect was -.05 for low parental education, 95% CI = [-.08, -.02] and .05 for high parental education, 95% CI = [.01, .09]) and Depressive Symptoms × Social Status × Parental Education effects (fall 8th grade standardized effect was 0.04 for high parental education, 95% CI = [.00, .08]; spring 10th grade was .06 for both low and high parental education, 95% CI low = [.02, .10], 95% CI high = [.02, .11]). In plots probing the three non-null three-way interactions involving parental education, different patterns emerged for the moderating effects of social integration (in spring 7th) and social status (in fall 8th and spring 10th). In the social integration model, depressive symptoms increased risk for substance use for everyone, but the strongest depressive symptoms–substance use association was evident for those with lower social integration and lower parental education (Figure 3). Indeed, whereas greater social integration exacerbated risk for depression-related use in youth with lower parental education, greater social integration actually dampened risk for depression-related use in youth with moderate or high parental education.

In social status models, a similar pattern was found in both fall 8th grade and spring 10th grade (Figure 4). The strongest effects for moderation were in youth with low parental education for whom depressive symptoms increased risk for substance use if they had high social status and decreased risk for use if they had low social status. For youth with medium and high levels of parental education, the same pattern was evident (although muted in high school, spring of 10th grade, when compared with middle school, fall 8th grade)—depressive symptoms were weakly associated with greater risk for substance use similarly for youth of low and high social status.

Discussion

The current study tested whether social integration and status in school social networks moderated risk for substance use associated with depressive symptoms and whether this moderating effect varies by gender, parental education, and race/ethnicity. Findings indicate that social standing within the social network indeed modifies depressive symptoms–substance use associations. First, substance use escalates most quickly in high school for youth with higher depres-
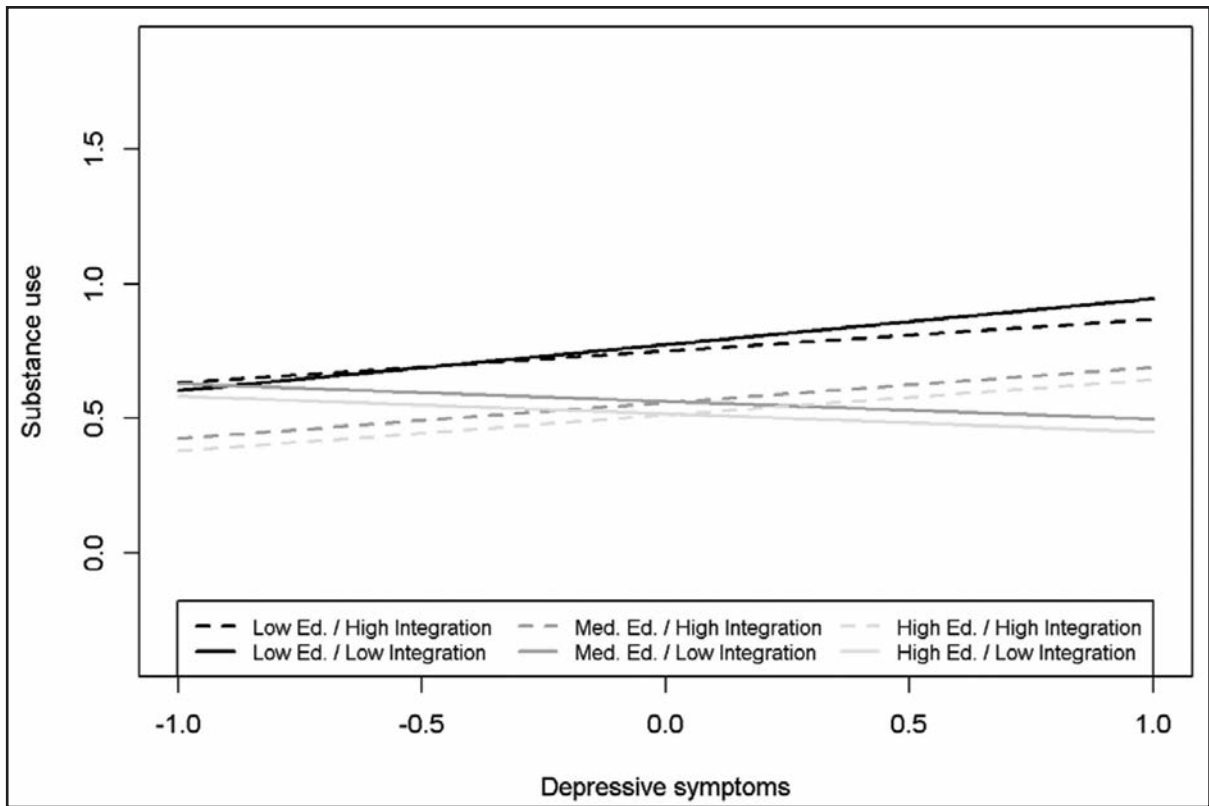
FIGURE 3.   Three-way interaction between depressive symptoms, education, and social integration predicting time-varying substance use in the spring of 7th grade. *Note:* Ed = education; integration = social integration; med. = medium.

sive symptoms and lower social integration or status across adolescence, suggesting that social experiences interact with depressive symptoms to create risk factors that can identify who is at risk for substance use during these years of rapid initiation. Second, individuals increased their substance use around the high school transition if they had greater depressive symptoms and either higher social status or lower social integration. But, third, these time-varying moderating effects of social network indicators on depressive symptom–substance use associations varied based on youth gender and socioeconomic status (as indicated by parental education).

The moderating effects of social network indicators on depressive symptom–substance use associations may reflect multiple mechanisms that may be differentially linked to integration and status. Social integration (particularly as defined in our model) comprises local indices of network position involving immediate and direct connections that are often conceptualized as reflecting social support (e.g., Berman et al., 2000). Social status may be defined by both local and global ties (as done here) that reflect position in the larger network. As such, social status is more often conceptualized as reflecting flow of information in a network, norms- and trend-setting, and popularity. Although social status and integration may often be highly correlated (as they are in our data, particularly at lower grades), this is not

necessarily the case and they may act in concert or in isolation through a variety of social mechanisms.

One such mechanism is social isolation, perhaps best captured by low social integration. Particularly after the high school transition, we found that depression-related risk for substance use was exacerbated in those with lower social integration. Youth in this transition may be motivated to self-medicate in response to social isolation. (We found that this may be particularly true for boys after the high school transition and for youth with lower socioeconomic status in middle school, both risk groups for substance use more broadly.) A second mechanism is stress related to social marginalization. Youth may experience more social stress as a result of low social status, and this stress may exacerbate risk for substance use already associated with depression, fueling self-medication around the time of the high school transition. (We found that this effect may also be particularly true for boys after the high school transition.)

A third mechanism is social pressures to keep up with peers. Youth with greater depressive symptoms may experience these pressures more acutely. Indeed, we found that youth with more depressive symptoms who are deeply embedded in high school social networks (via status or integration) showed greater risk for substance use, maybe reflecting a greater sense of needing to fit in (to use substances simi-
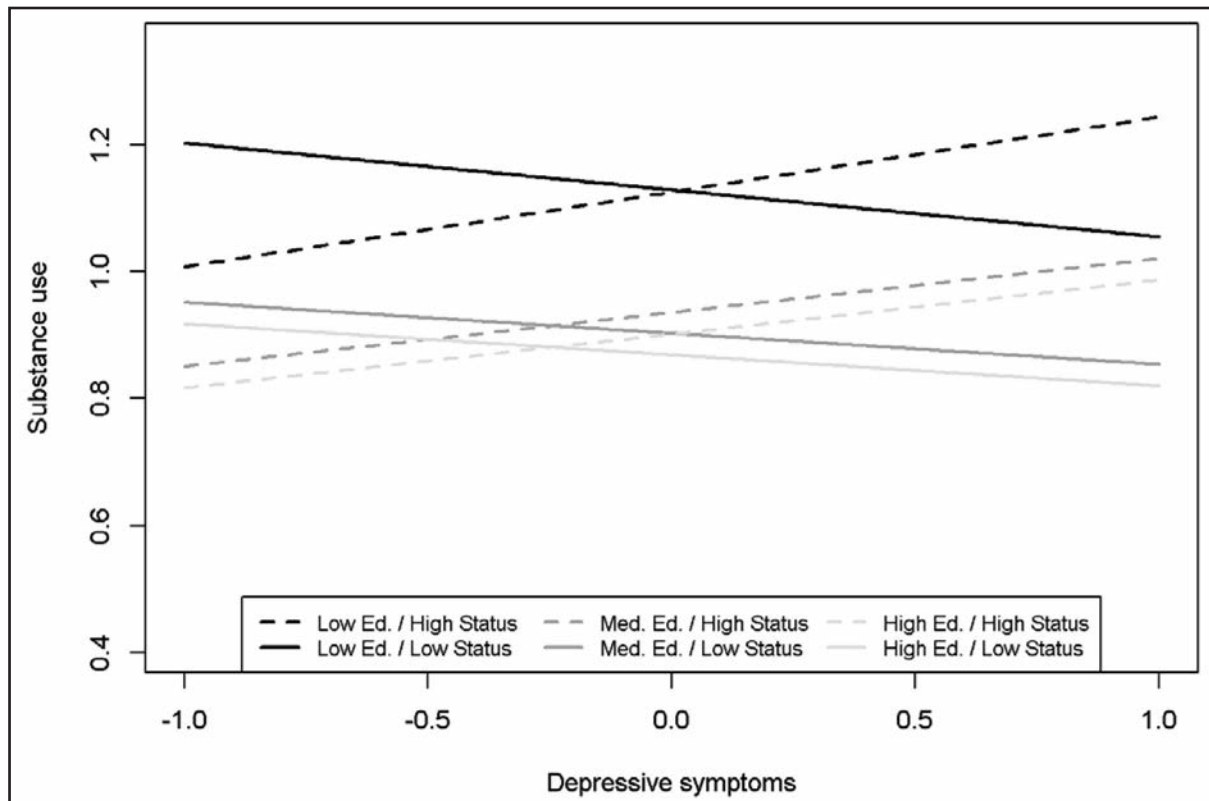
FIGURE 4.   Three-way interaction between depressive symptoms, education, and social status predicting time-varying substance use in the fall of 8th grade. *Note:* Ed = education; integration = social integration; med. = medium.

larly to their peers). (We found this effect particularly for girls just after the high school transition.) In some cases, this pressure may even result in greater risk for substance use as depressive symptoms increase (an effect that we found to be particularly true for youth with lower socioeconomic status).

The mechanisms linking social network experiences, depressive symptoms, and substance use sometimes varied by gender. We found that low social integration turned depressive symptoms into a protective factor for boys, but not girls, in high school. This pattern of effects is perhaps surprising but may reflect more than one mechanism at work. For boys with lower depressive symptoms, lower social integration in the school network may reflect engagement in non-school networks to a great extent—perhaps with older peers with more access to substances that encourage use. For boys with greater depressive symptoms, lower social integration may reflect social withdrawal (a symptom of depression) and isolation, reducing access to substances and reinforcement for use. Thus, social integration may differently affect risk for substance use because it is indexing different social experiences for youth depending on their depressive symptomatology.

The mechanisms linking social network experiences, depressive symptoms, and substance use sometimes also varied by socioeconomic status. The combination of lower

social integration and parental education predicted stronger depressive symptom–substance use associations in seventh grade, consistent with models of cumulative risk factors seen in the broader literature (Sampson & Laub, 1997). Social status models, however, suggested a slightly different pattern. Stronger depressive symptom–substance use associations were evident in eighth grade for those with higher social status, particularly for youth with lower parental education—indeed, lower social status was somewhat protective for all youth. These patterns were even stronger in 10th grade, when protective effects were more evident and risky effects were somewhat more dampened.

Despite these intriguing findings, limitations of the study should also be considered. Effects were generally modest, although models were highly stringent and predicted changes in substance use (i.e., intercepts and slopes of trajectories or time-specific deviations from an individual's underlying trajectory of substance use). Model complexity did not permit us to control for the potentially confounding effects of time-varying deviance (although we did control for time-invariant deviance). Finally, although we anticipate that the mechanisms underlying associations among depressive symptoms, social network indicators, and substance use are dynamic, cyclical, and cumulate over development such complexity is not reflected in current analyses.

Together these findings suggest that lower integration into the social network exacerbates risk for depression-related substance use in youth; however, social status showed a more varied pattern. High social status exacerbated the depressive symptoms–substance use association around the high school transition in general. But low social status also increased risk for depression-related substance use after this transition in males, whereas low social status was even protective against this risk in certain youth (8th and 10th graders with lower or high parental education). These findings suggest that the meaning of social status may vary outside of acute school transitions depending on youths' other risk factors for substance involvement. Perhaps social status across the high school transition is a good proxy for who first gets access to substances. High-status youth with elevated depressive symptoms may then be more likely to use substances across this transition because they have both motivation (coping with negative mood) and access. However, as alcohol becomes more readily available across all social groups, social status could fade as a proxy for access to substances and no longer serve to identify added risk for coping-motivated substance use. Further research is needed to identify the developmentally sensitive functions of social status and integration with respect to youth substance use.

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