

Multilevel Modeling of Direct Effects and Interactions of Peers, Parents, School, and Community Influences on Adolescent Substance Use

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Abstract This study tested a social-ecological model of adolescent substance use. Multilevel modeling was used to investigate how systems, such as parents, peers, schools, and communities, directly influence and interact together to influence adolescent substance use. Participants included 14,548 (50.3% female) middle school students who were 78.6% White, 5.4% Biracial, 4.8% Asian, 4.8% Black, and 3.6% Hispanic. Participants completed a survey with scales assessing substance use, peer influences, parental influences, and characteristics of their school and community. Hierarchical linear modeling (HLM) was used to consider the variation of parental and peer influences on substance use and how schools and communities relate to both substance use and the relationship between substance use and peer and parental factors. Results indicated that a positive school climate and a positive sense of community were associated with less adolescent substance use and that a positive sense of community moderated the relation between peer and parental influence on adolescent substance use, thereby acting as a protective factor.

Keywords Adolescent risk behavior · Substance use · Community · School · Parent · Peers · Contextual factors

Introduction

Psychologists have utilized a multifactorial approach to determine the correlates, processes, and outcomes involved in healthy adolescent development. Bronfenbrenner's seminal work was instrumental in developing an initial framework for conceptualizing contextual influences on development. This conceptual framework postulates that adolescent development is shaped by a range of nested, contextual systems whose joint impact is remarkably influential in healthy adolescent development (Bronfenbrenner 1977; Jessor 1993). The purpose of this study was to empirically examine the relations among community and school contexts, parental and peer factors, and adolescent substance use. The current study built upon previous research that demonstrated the importance of both parental and peer influences and community and school contexts on adolescent substance use. The current study used multilevel models to examine how contextual variables influence substance use and how parental and peer influences on substance use are moderated by community and school variables.

Community and School Contexts

A substantial body of empirical and theoretical research links community and school conditions to adolescent substance use. Social disorganization theory attributed deviant behavior to socially disorganized cities, which are characterized by impoverished economic and social conditions that limit a community's ability to control or supervise

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adolescent behavior (Shaw and McKay 1942). Wilson's seminal work (1987) revived social disorganization theory by noting poverty effects on family processes and outcomes. Researchers have supported these ideas and found that non-parental adults within a community can play a critical role in adolescent development by sharing the responsibilities of monitoring adolescents (Sampson et al. 1997) and that living in an unsafe community was a significant risk factor for externalizing behaviors among youth (Pettit et al. 1999). Thus, in the current study, perceiving one's community as safe and supportive was believed to be predictive of less substance use among adolescents.

In addition to community factors, schools also play an integral role in shaping adolescent behavior (Bond et al. 2007; Cleveland et al. 2005). The climate of schools has been described as the beliefs and attitudes held by the majority of students in a school and has also been defined as the extent to which students feel they are respected and are receiving a good education. Schools have long been seen as rich social contexts that have direct and indirect effects on child development (Bronfenbrenner 1979); however, schools differ across child outcomes because of variability in social organization, peer group dynamics, teachers' roles, etc. What is less known is how school climate interacts with other contexts, such as peers and parents, to influence substance use. Thus, this study examines whether attending a school where students perceive a positive school climate will moderate the effect that peers and parents have on adolescent substance use.

Parent and Peer Influences

Much research has supported the notion that family functioning is a formative contextual factor in determining the emergence of healthy or unhealthy adolescent development. More specifically, research has shown that positive parental attachment, caring, support, monitoring, and values also play a significant role in explaining adolescents' attitudes and behaviors. One theory that has helped embody part of the influence of parental processes on child development is self-control theory (Gottfredson and Hirschi 1990), which was derived from Hirschi's original control theory. Self-control theory postulates that low self-control and a weak bond to society creates conditions favorable for involvement in deviant behaviors. This theory recognized that parental factors, such as monitoring, parent-child relationship, and discipline, are major sources of child socialization. Children whose parents care about them, monitor their whereabouts and friendships, and use effective discipline developed the self-control that is associated with less involvement in risky behaviors, such as alcohol and drug use.

Considering the above empirically supported theory, the parental factors examined in the current study include monitoring, parental values, support, and communication with adolescents about risky behavior. Parental monitoring has been shown to reduce problematic behavior among adolescents (Dishion et al. 1988; Leventhal and Brooks-Gunn 2000; Metzler et al. 1994) including drug use (Denton and Kampfe 1994). Research has also indicated that communication between parents and adolescents about risky behaviors is highly related to monitoring (see Kerr and Stattin 2000) and is an influential factor in reducing adolescent problematic behavior (Chassin et al. 1998). Similarly, empirical work has suggested that parents who are responsive and show care for their children have been remarkably successful in protecting their adolescents from involvement in risky behavior (Marta 1997). Finally, Hawkins and Fitzgibbon (1993) speculated that adopting non-conventional values from parents would be associated with greater adolescent involvement in problematic behavior.

In addition to parental factors, researchers have also suggested that as children get older their peer group becomes more influential while familial factors become less influential (Goldstein et al. 2005). Using self-control theory as a framework, Thompson et al. (1984) indicated that the variation in adolescent delinquency is best accounted for by a combination of family process and the peer group. Association with peers who display deviant behavior is consistently predictive of adolescent deviant behavior (Patterson et al. 2000; Warr 2002). As these studies indicate, adolescent substance use is influenced by their peer group and therefore, will be examined in the current study.

In summary, strong theoretical and empirical support has been demonstrated for the saliency of parents, peers, community, and school contexts on the development of substance use. Few researchers have focused on the interactions of these contexts (see Breyers et al. 2003; Hawkins et al. 2004; Wallace et al. 2007). Thus, an objective of the current study was to empirically demonstrate the interactions between these contexts (e.g., family and peers interacting with school and community).

Interaction of Multiple Systems

Support for the current study's hypotheses and analyses are drawn from the work of Leventhal and Brooks-Gunn (2000) who extended the work of Jencks and Mayer (1990) and Sampson (1997) that demonstrated both positive and negative neighborhood effects on adolescent individual behaviors. Leventhal and Brooks-Gunn discussed the potential mechanisms through which multiple contexts (e.g., family, neighborhood) interact to influence child development. Drawn primarily from the social disorganization models, Leventhal and Brooks-Gunn described institutions or

mechanisms that are in place to maintain control in a neighborhood. For example, they argued that neighborhood characteristics might have an indirect effect on adolescent deviant behavior through the mediating role of the parents' ability to supervise and monitor their children's behavior (Sampson 1997). Additionally, there is evidence that peers moderate neighborhood effects, such that high levels of positive peer support lead to a decrease in deviant behavior for children who live in impoverished neighborhoods might increase deviant behavior among children from the same neighborhoods that have less positive peer exposure (Hawkins et al. 2004). The current study expands on this theoretical formulation and considers whether community/school contexts moderate the association between parent/peer factors and adolescent substance use.

Hypotheses

In this study, Hierarchical Linear Modeling (HLM; Raudenbush and Bryk 2002) was used to consider the variation of parental and peer influences (Level 1 variables) on risk behaviors while also evaluating the influences of school and community (Level 2 variables), thereby creating a more complete model of the dynamics of various factors influencing adolescent substance use. It was hypothesized that the current study would support past research, as described above, in showing that adolescents who report that their peers engage in risky behaviors would engage in more substance use and that adolescents who perceive their parents as not supporting them, not knowing about their lives, and having values that condone risky behaviors would engage in more substance use. Additionally, adolescents who report a negative sense of community or school climate would engage in greater substance use. The current study extends these research findings by hypothesizing that school climate and sense of community will act as moderators for the relationship between substance use and parental and peer influences, specifically, negative peer and parental factors would be less influential in predicting substance use when adolescents perceive a positive school climate and a sense of community.

Method

Participants

Participants were 14,548 high school students from 19 schools in a United States Midwestern county. The sample consisted of 49.7% males and 50.3% females. With respect to race, 78.6% of the respondents identified themselves as White, 5.4% identified as Biracial, 4.8% identified as

Asian, 4.8% identified as Black, and 3.6% identified as Hispanic. The mean age of the students was 14.5 years old (See Table 1 for sample demographics).

Procedures

Data were collected in collaboration with school administrators, teachers, and community representatives. The school district mailed passive consent forms to parents of all registered students and returned surveys for 90 through 95% of their student population. Families were given opportunities to review the surveys before their student participated. At the beginning of data collection, students were informed that their names would be converted to numbers once the surveys were collected, participation was voluntary, and no teachers or parents would have access to their answers. Students who elected not to participate were supervised in another classroom. The survey lasted approximately 40 min.

Measures

Since 1980, the Dane County Youth Assessment (DCYA) has been administered to 7–12th graders in regular 5 year intervals and was developed by representatives from 14 of the 16 school districts, five funding organizations, and several academic researchers. In addition to this rigorous and careful developmental process, exemplifying the validity of this questionnaire, this questionnaire also was empirically validated using both exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). In the current study, students completed the Dane County Youth Survey 2005 (Koenig et al. 2005). See Appendix for measures used in the current study.

First, an exploratory factor analysis (EFA) of items from the 2000 DCYA was performed and then results from the EFA informed the construction of measurement models using confirmatory factor analysis (CFA) from data collected in 2005. CFAs with robust maximum likelihood estimations were conducted using LISREL 8.2 (Jöreskog and Sörbom 1998). Two criteria were used in retaining a preliminary factor structure: (a) factor loadings that exceeded .40 were retained (Floyd and Widaman 1995), and (b) cross loadings greater than .40 were eliminated. The intent was to maintain both theoretical and conceptual plausibility. The results of these analyses are presented below.

Level 1 Variables

Parental Factors

Parental communication The first factor was parental communication. Participants are asked if they talked with

Table 1 Study sample size grouped by schools and demographics

School	Total	Sex		Race						Grade			
		M	F	B	NA	His	As	W	Bi	9th	10th	11th	12th
1	1,176	591	585	44	14	45	25	981	45	307	312	262	290
2	1,334	669	665	68	21	32	45	1,095	55	376	354	325	275
3	1,526	756	770	31	10	23	50	1,342	51	405	391	374	347
4	231	118	113	0	2	3	1	218	6	69	57	58	47
5	297	152	145	2	2	4	4	261	17	75	87	65	68
6	532	274	258	8	2	6	15	465	21	152	125	134	116
7	296	144	152	2	1	22	3	261	5	78	83	62	73
8	80	43	37	3	2	8	0	61	5	0	21	32	27
9	330	177	153	3	6	3	5	302	7	84	95	71	80
10	172	80	92	1	2	2	2	156	6	42	51	40	38
11	756	390	366	19	7	15	16	652	39	203	221	176	153
12	513	247	266	5	4	9	2	478	13	134	139	109	127
13	867	457	410	11	5	14	16	771	41	233	244	214	170
14	952	484	468	12	10	14	21	841	45	276	237	222	214
15	1,225	593	632	139	12	72	138	737	89	326	325	304	263
16	2,982	1,426	1,556	216	24	174	277	1,970	240	766	747	803	648
17	1,100	542	558	99	11	59	62	761	83	311	251	293	220
18	101	42	59	14	0	4	3	56	15	0	30	36	35
19	78	42	36	22	2	11	15	23	2	0	0	34	41
Total	14,548	7,227	7,321	699	137	520	800	11,431	785	3,857	3,770	3,614	3,232

Note: M Male, F Female, B Black, NA Native American, His Hispanic, As Asian, W White, Bi Biracial

at least one parent about sex, drugs, personal issues, or their future in the past 12 months ($\alpha = .78$). Response options range from 0 (*Never*) through 4 (*Very often*).

Parental values Second, a four-item scale about parental values asks participants how much they agree with statements assessing their parents’ opinions about specific risky behaviors, such as sex, alcohol, smoking, and drugs ($\alpha = .85$). Response options range from 1 (*Strongly agree*) through 5 (*Strongly disagree*).

Parental knowledge Third, a two-item scale on parental knowledge assesses how often their parents know their whereabouts ($\alpha = .76$). Response options range from 0 (*Never*) through 4 (*Very often*).

Parental support Fourth, a two-item scale about parental support assesses how much participants feel that their parents care about them and whether their parents are there when they need them ($\alpha = .77$). Response options range from 0 (*Never*) through 4 (*Very often*).

EFA with maximum likelihood method of extraction and a varimax rotation yielded these four distinct parental factors. A CFA testing the four factor solution indicated a good fit for these data when considering multiple indexes of fit (RMSEA = .06; GFI = .98; AGIF = .96; CFI = .90).

Peer Influence

A four-item scale asks how much participants agree or disagree with statements about their friends’ positive influence ($\alpha = .83$). Response options range from 0 (*Strongly agree*) through 3 (*Strongly disagree*). EFA yielded that this scale was unidimensional with an alpha coefficient of .84. A CFA yielded a good fit for these data (RMSEA = .02; GFI, AGFI, CFI = 1.00). The scale was reversed score, such that higher scores indicated positive peers.

Level 2 Variables

School Climate

An eight-item scale assesses how much students feel that they are getting a good education and are respected and cared about by adults at their school ($\alpha = .73$). Response options range from 0 (*Strongly agree*) through 3 (*Strongly disagree*). This scale was reversed scored such that higher scores indicate positive school climate. This scale emerged in an EFA as distinct and a CFA indicated a good fit for these data when considering multiple indexes of fit (RMSEA = .09; GFI = .95; AGIF = .92; CFI = .95).

Sense of Community

A five-item scale assesses students' perceptions of sense of community and adult involvement and care ($\alpha = .77$). Response options range from 0 (*Strongly agree*) through 3 (*Strongly disagree*). Items are scored so that higher scores indicate a more positive sense of community. EFA yielded a unidimensional factor with a Cronbach's alpha coefficient of .70. A CFA yielded a good fit for these data (RMSEA = .06; GFI = .99; AGFI = .97; CFI = .99).

Outcome Variables

Alcohol/Marijuana and Cigarette Use

Several researchers have combined substances into a composite variable, reflecting that substances are frequently used concurrently and have similar psychosocial correlates (Zapert et al. 2002), while others have noted that the correlates of various substances are unique and examine them as separate outcomes (Wallace et al. 2007). Considering both theory and empirical work of other researchers and our empirical analyses, the two outcome measures in that study are alcohol/marijuana use and cigarette use. The alcohol/marijuana scale consists of three items and asks students how often in past 30 days they used: beer/wine, hard alcohol, and marijuana ($\alpha = .85$). The second scale consisted of two items and asked students how often in the past 30 days they smoked cigarettes and the amount they smoked ($\alpha = .93$). Response options range from 0 (*No use*) through 5 (*Daily use*) and 0 (*Did not smoke*) through 6 (*More than 20 per day*), respectively. These scales emerged as distinct factors in the EFA and the CFA yielded two distinct factors and indicated a good fit for these data when considering multiple indexes of fit (RMSEA = .06; GFI = .95; AGIF = .92; CFI = .92).

Results

Descriptive Statistics

Means, standard deviations, and correlations for the study scales are shown in Table 2. Correlations among the parental factor scales indicate that these scales are modestly related but distinct constructs, with correlation coefficients ranging from .08 through .44. Additionally, school climate and sense of community are also related but distinct variables ($r = .44$, $p > .01$). In addition, alcohol/marijuana and cigarette use were moderately associated ($r = .55$, $p > .01$), but not enough to warrant combining them into one scale. While the large sample size incline significant correlations, the low strength of the correlations allow for further examine of these scales.

Table 2 Correlations among all study variables

Variable	Parental communication	Parental support	Parental knowledge	Parental values	Peer influence	Sense of community	School climate	Cigarettes	Alcohol/Marijuana
Parental communication	.78								
Parental support	.35	.77							
Parental knowledge	.31	.44	.76						
Parental values	.08	.17	.30	.85					
Peer influence	.10	.19	.37	.37	.84				
Sense of community	.19	.31	.30	.25	.35	.77			
School climate	.19	.27	.27	.27	.37	.44	.73		
Cigarette use	-.04	-.19	-.31	-.3	-.43	-.25	-.24	.93	
Alcohol/marijuana	-.04	-.19	-.40	-.42	-.59	-.28	-.32	.55	.85
Scale mean (SD)	1.88 (.97)	3.56 (.87)	3.32 (.87)	4.17 (.86)	1.72 (.79)	1.90 (.59)	1.77 (.51)	.53 (1.34)	.85 (1.04)

Note: Alpha coefficients for study the for the 2005 Dane County scales can be found along the diagonal

To test for differences on the study measures across sex, race, and grade, a MANOVA was conducted with outcome variables (alcohol/drug, cigarette use) and Level 1 predictors (parental factors and peer influence) as dependent variables, and individuals' sex, race, and grade as independent variables. The MANOVA was significant for sex, race, and grade, however considering the negligible *Eta Squares* (ranging from .00 to .02) and the large sample size, analyses were run with the entire sample.

Multilevel Analysis

Multilevel models of contextual and moderating effects were constructed using the software program HLM 6.0 (Bryk et al. 1996). HLM is a statistical technique that models the effects of nested data (e.g., students nested in schools) by accounting for the interdependence of students within the same school and models both school level (Level 2) and individual level (Level 1) variances on the outcome variables (alcohol/marijuana and cigarette use). Therefore, HLM improves the estimation of individual effects and models cross-level effects, allowing for analyses of the interaction of various contexts and its effects on adolescent substance use. Three steps are involved in developing a two-level hierarchical linear model. In step 1, an unconditional model estimates if schools vary on the outcome variables (alcohol/marijuana and cigarette use). In step 2, each Level 1 and Level 2 variables are then regressed on the outcome variable to determine their direct effects and if the slopes of these effects vary between schools. Lastly, in step 3, a final model is constructed using the results from the prior models to determine contextual and moderating effects.

Step 1

First, a fully unconditional (null) model was estimated, which was analogous to conducting a one-way random effects ANOVA. Results from the model were used to determine the extent to which students within the same school were similar to each other in the frequency of alcohol/marijuana use or cigarette use. Specifically, 12 and 18% of the variance in scores existed between schools for alcohol/marijuana use and cigarette use, respectively ($\chi^2 = 447.49; 1,187, p < .05$).

Step 2

Level 1 Next, we examined the relationship between individual level peer and parental influences on alcohol/drug use and cigarette use. For the model with alcohol/marijuana use as the outcome variable, results suggested that peer influence, parental communication, knowledge,

and values were all significant predictors of school level alcohol/marijuana use (Table 3) and that the peer influence, parental knowledge and parental values slopes were heterogeneous across schools (Table 3). Therefore, these variables were modeled as random in subsequent models.

For the model with cigarette use as the outcome variable, results indicated that peer influence, parental communication, parental knowledge, parental support, and parental values were all significant predictors of school level cigarette use (Table 3) and that peer influence, parental knowledge, and parental support slopes varied significantly between schools and were modeled as random variables in subsequent models (Table 3). Parental communication and parental values did not significantly vary between schools and was treated as a fixed variable in subsequent models.

Level 2 Next we investigated the relationship between substance use and school level sense of community and school climate. These variables were created by aggregating student's response within a school which is a common method used in multilevel analysis (Raudenbush and Bryk 2002). Results indicated a significant association between school mean Level 2 variables and alcohol/marijuana use among students. Specifically, 23% of the variance at Level 2 was explained by school climate and 84% was explained by a sense of community. And results with Level 2 variables as independent variables and cigarette use as the outcome variable indicated 26% of the variance at Level 2 was explained by school climate and 79% was explained by a sense of community. Therefore, feeling a sense of community and/or living in a positive school climate tended to be associated with less substance use.

Step 3

The final model integrates all Level 1 and Level 2 variables and tests for the moderating effects of Level 2 variables on adolescent substance use. Specifically, this model investigated whether the strength of the relationship between individual level peer and parent influence and adolescent substance use varies depending on the school climate or sense of community experienced by the students. Individuals' scores on Level 1 variables were first grand-mean centered and entered at Level 1. Centering the independent variables at Level 1 is recommended as a way to make the interpretation of the coefficients more meaningful (Raudenbush and Bryk 2002). The school average scores on school climate and positive sense of community were entered at Level 2, representing the hierarchy enhancing or attenuating nature of the school social environment. An example of the HLM equation used is below:

Table 3 Random coefficient model for alcohol/marijuana and cigarette use

Fixed effects	Alcohol/marijuana			Cigarette use		
	Coefficient	se	t-ratio	Coefficient	se	t-ratio
Overall effect (γ_{00})	.85	.02	–	.68	.07	–
Peer (γ_{01})	.60	.03	21.52*	.62	.05	12.06*
Parental communication (γ_{02})	.08	.01	9.79*	.12	.02	7.37*
Parental knowledge (γ_{03})	.22	.02	13.30*	.26	.03	10.10*
Parental support (γ_{04})	.03	.02	1.67	.12	.03	4.65*
Parental values (γ_{05})	.24	.01	18.36*	.22	.02	12.66*
Random effects	Variance	df	χ^2	Variance	df	χ^2
School mean (μ_{10})	.01	18	58.80*	.08	18	457.56*
Peer (μ_{11})	.01	18	60.85*	.04	18	153.05*
Parental communication (μ_{12})	.02	18	19.23	.00	18	26.65
Parental knowledge (μ_{13})	.00	18	39.67*	.01	18	68.65*
Parental support (μ_{14})	.01	18	38.99*	.01	18	43.65*
Parental values (μ_{15})	.00	18	28.72*	.00	18	32.66
Level-1 effect (σ_{ij})	.62	18		1.32		

Note: Overall effect, γ_{00} = average of school means across the population of schools; γ_{ij} = average regression slope across schools; μ_{ij} = unique sloped between schools

* $p < .05$

$$\begin{aligned} \text{Alcohol/drug} = & \beta_{0j} + \beta_{1j}(\text{positive peer influence}) \\ & + \beta_{2j}(\text{parent communication}) \\ & + \beta_{3j}(\text{parent knowledge}) \\ & + \beta_{4j}(\text{parent support}) \\ & + \beta_{5j}(\text{parent values}) \\ & + r_{ij} \end{aligned}$$

$$\beta_{0j} = \gamma_{00} + \gamma_{01}(\text{SCHOOL CLIMATE})_j + u_{0j}$$

$$\beta_{1j} = \gamma_{10} + \gamma_{11}(\text{SCHOOL CLIMATE})_j + u_{1j}$$

The school average scores on school climate and positive sense of community were entered at Level 2, representing the hierarchy of the school social environment.

Community effects Results from the models with a sense of community as the Level 2 variable indicate that mean positive sense of community scores are negatively related to school mean alcohol/marijuana use, ($\gamma_{01} = -0.40$, $t = -3.06$, $p < .05$; see Table 4) and school mean cigarette use, ($\gamma_{01} = -1.69$, $t = -5.18$, $p < .05$; see Table 4). This indicates that having a positive sense of community was associated with less alcohol/marijuana use and cigarette use.

A significant moderating effect was found between peer influence and sense of community, suggesting that the mean sense of community moderates the effects of peer influence on alcohol/marijuana use ($\gamma_{11} = -0.41$, $t = -3.78$, $p < .05$, see Table 4) and cigarette use ($\gamma_{11} = -1.00$, $t = -4.19$, $p < .05$; see Table 4). There is a tendency for schools in more positive communities to have

smaller slopes, indicating that peer influence on alcohol/marijuana and cigarette use is moderated by a positive sense of community. Therefore, peer influence has a greater influence on whether adolescents will use substances when an adolescent does not feel a strong sense of positive community. Additionally, a moderating effect was found between parental support and sense of community, suggesting that the mean sense of community moderates the effects of unsupportive parents on alcohol/marijuana use ($\gamma_{41} = -0.44$, $t = -3.72$, $p < .05$, see Table 4) and cigarette use ($\gamma_{41} = -0.63$, $t = -3.77$, $p < .05$; see Table 4). These results encourage more research on school and community level variables that might help explain the remaining variance.

School effects Results from the models with school climate as the Level 2 variable documented significant contextual effects between school climate and mean alcohol/marijuana use ($\gamma_{01} = -4.2$, $t = -2.14$, $p < .05$; see Table 5) and school climate and cigarette use ($\gamma_{01} = -1.32$, $t = -2.31$, $p < .05$; see Table 5). Thus, the effect of being in a positive school climate helps explain between-group differences of alcohol/marijuana and cigarette use among adolescents. No moderating effects were found.

Discussion

Many scholars across disciplines have studied the complexities of contexts in which adolescents develop. The

Table 4 Hierarchical models for the effect of sense of community on adolescent substance use

	Coefficient	se	t-test	Original variance (Null model)	Residual variance (Contextual model)	Proportion of variance explained (ICC)
<i>Alcohol/marijuana</i>						
				.12	.02	84.0%
Sense of community contextual effect (γ_{01})	-.40	.13	-3.06*			
Peer (γ_{11})	-.41	.11	-3.78*			
Parental comm. (γ_{21})	.01	.11	.07			
Parental knowledge (γ_{31})	.00	.15	.01			
Parental support (γ_{41})	-.44	.12	-3.72*			
Parental values (γ_{51})	-.11	.11	-.91			
<i>Cigarette use</i>						
				.38	.08	79%
Sense of community contextual effect (γ_{01})	-1.69	.32	-5.18*			
Peer (γ_{11})	-1.00	.24	-4.19*			
Parental comm. (γ_{21})	.13	.15	.91			
Parental knowledge (γ_{31})	.03	.16	.88			
Parental support (γ_{41})	-.63	.17	-3.77*			
Parental values (γ_{51})	-.12	.16	-.47			

Note: Sense of community contextual effect = Effect of aggregate Level 1 sense of community predicting alcohol/drug use or cigarette use after controlling for the effect of individual sense of community. Peer = Effect of peer influence accounting for variance between groups. Parent comm. = Effect of parental communication accounting for the variance between groups. Parent knowledge = Effect of parental knowledge accounting for the variance between groups. Parent care = Effect of parental care accounting for the variance between groups. Parent values = Effect of parental values accounting for the variance between groups. Original variance refers to the parameter variance under the unconditional null model. Residual variance refers to the parameter variance under the contextual model. Proportion of variance explained, or interclass correlation, refers to the proportion of variance of alcohol/drug use explained between schools by a sense of community

* $p < .05$

results of the present analyses indicate that community and school contexts interact with parental and peer factors and influence adolescent substance use. Even after taking into account the variance that parents, peers, school, and community have individually on substance use, community and school factors moderated the influence of parents and peers. This study supports the social-ecological framework (Bronfenbrenner 1979) by showing that contexts influence development and that the interaction of these contexts can provide protective factors for adolescent substance use. To further our understanding of adolescent substance use, we can not limit our discussion to the individual problem behavior, but also consider how to promote protective factors in the environment. Adolescent behavior cannot be understood or treated without understanding their relationships with the social systems in which they interact.

Although a plethora of investigations have been conducted on identifying risk and protective factors of adolescent substance use, few investigations have examined how these systems interact together to protect adolescents from engaging in substance use. Findings of the current study are consistent with previous research in which peers and parental factors influenced substance use (Dishion et al. 2004; Gottfredson and Hirschi 1990; Patterson et al. 2000). The current study also supported the contentions of

Bronfenbrenner (1979) in that results indicated that both social contexts and social influences affected use.

Many of the study’s hypotheses were confirmed. It was hypothesized that a significant amount of variance in adolescent self-reported alcohol/marijuana and cigarette use would exist between schools. Analysis of the unconditional models confirmed this hypothesis by showing that the amount of self-reported substance use varied based on which school students attended. It was hypothesized that both peer and parental factors would have a direct effect on substance use. This hypothesis was confirmed, supporting the vast amount of literature suggesting the influence of parents and peers on adolescent substance use. It was also hypothesized that a perception of positive school climate and a sense of community would account for a significant amount of variance between schools. This hypothesis was also confirmed; results indicated that both Level 2 variables (school climate and sense of community) influenced the school mean level substance use. Thus, each of these contextual variables had a significant association to how much adolescents in a school were engaging in substance use. For example, perceptions of a positive community was associated with less substance use. These findings are consistent with the literature, supporting that contextual variables have an impact on adolescent behavior (Eitle and Eitle 2004). This study also adds to this

Table 5 Hierarchical models for the effect of school climate on adolescent substance use

	Coefficient	se	t-test	Original variance (Null model)	Residual variance (Contextual model)	Proportion of variance explained
<i>Alcohol/marijuana</i>						
				.12	.03	25.0%
School climate contextual effect (γ_{01})	-.42	.20	-2.14*			
Peer (γ_{11})	.13	.11	1.15			
Parental comm. (γ_{21})	-.07	.09	-.76			
Parental knowledge (γ_{31})	-.18	.16	-1.15			
Parental support (γ_{41})	.12	.17	.72			
Parental values (γ_{51})	-.13	.14	-.94			
<i>Cigarette use</i>						
				.38	.28	26.0%
School climate contextual effect (γ_{01})	-1.32	.57	2.31*			
Peer (γ_{11})	-.74	.38	-1.91			
Parental comm. (γ_{21})	.05	.15	.30			
Parental knowledge (γ_{31})	.10	.25	.38			
Parental support (γ_{41})	-.24	.24	-.85			
Parental values (γ_{51})	.00	.21	.03			

Note: School climate contextual effect = Effect of aggregate Level 1 school climate predicting alcohol/drug use or cigarette use after controlling for the effect of individual school climate. Peer = Effect of peer influence accounting for variance between groups. Parent comm. = Effect of parental communication accounting for the variance between groups. Parent knowledge = Effect of parental knowledge accounting for the variance between groups. Parent care = Effect of parental care accounting for the variance between groups. Parent values = Effect of parental values accounting for the variance between groups. Original variance refers to the parameter variance under the unconditional null model. Residual variance refers to the parameter variance under the contextual model. Proportion of variance explained refers to the proportion of variance of alcohol/drug use explained between schools by school climate

* $p < .05$

literature by suggesting that these contextual variables have direct effects on adolescent substance use.

Additionally, it was hypothesized that the contextual variables (school climate and sense of community) would moderate the effects of both peer and parental influences on substance use. This hypothesis yielded mixed results because only certain contextual variables moderated the influence of peers and/or parents. More specifically, adolescents who report living in a positive community were less likely to engage in both alcohol/marijuana use and cigarette use even when they associated with peers who engaged in risk behaviors or had parents whom they felt did not support or care for them. Therefore, negative peer behavior and lack of parental support appeared to have a greater influence on alcohol/marijuana use and cigarette use for those adolescents who reported living in communities where they did not feel connected. Research suggests that contact and association with peers who engage in risky behavior is a critical factor in adolescent substance use (Dishion et al. 1997). The current study advances the literature by demonstrating the potential buffering effect of communities against peer pressure and substance use.

Although many of the study's hypotheses received support, we did not find that school climate moderated the

relation between peer and parental influence on substance use. While a positive school climate was found to be associated with less alcohol/marijuana use, this association did not buffer the effects of peer influence or negative parenting practices on adolescent substance use. Further examination of school climate and the messages adolescents receive specifically about substance use might help improve our understanding of how and what types of school climate might impact substance use. This reminds us of the complexity of these relationships and that further evaluation of these contexts is necessary.

Overall, results from this study suggest that adolescents' views of their school and community not only associated with the amount of substance use they report, but these contextual systems might protect these adolescents from the strong influences of negative peer pressure and negative parenting attitudes and behavior. This study empirically supports the ecological model (Bronfenbrenner 1977) as well as the contentions of Leventhal and Brooks-Gunn (2000) in empirically demonstrating the effects of the interaction of multiple contexts on adolescent substance use. Additionally, this study underscores that researchers should consider both school and community as important contextual factors. The complexities of the ecological

model have made it challenging to empirically validate. The current investigation empirically supported the importance of both individual contexts such as community, school, peers, and parents and the interaction of contexts. The unique contribution of the current study is that the importance of interactions between various systems was empirically demonstrated. Not only was each context (peers, parents, school, and community) a significant influence on substance use, but also the interactions of these contexts also significantly influenced substance use.

Not only has this study provided empirical support for understanding the interaction of the contexts in which adolescents develop, but more specifically, this study also helped expand the knowledge on adolescent substance use. Substance use among adolescents continues to be a growing concern among schools, parents, and communities as prevalence is high among adolescents (NIDA 2008) and contributes to adolescent death (NIAAA 2007). Additionally, adolescent substance use increases the risk for mental health problems, such as conduct disorder, depression, anxiety, and drug dependence (Brown et al. 2001). While the field has made advancements in effective treatment modalities, such as CBT, family therapy, and multisystemic therapy (Wagner and Waldron 2001), only a small proportion of adolescents who use substances receive treatment and therefore do not take advantage of these advancements. For both clinical and cost-effective reasons, it is critical for treatment providers to go beyond the individual and family and consider the systems that influence adolescent development.

It is important to consider that, despite the strengths of this study, several limitations of this study warrant cautious interpretation of the results. The study did not consider individual characteristics of adolescents, such as personality, personal values, self-esteem, and psychopathology, or the role these characteristics might play in risk behavior. Numerous studies have demonstrated the importance of individual characteristics to the expression and development of adolescent risky behavior (Dishion and Patterson 1997). Future research might address this issue by considering how individual factors relate to various contexts and substance use. Similarly, a need exists to assess each context over time. Bronfenbrenner (1979) suggests that it is not enough to assess the individual and the process, but to include the individual and the contextual processes and to study the dynamic relations between these two processes. And, lastly, the sample consisted of high school students from a midwestern county that was largely White and rural/suburban. Thus, it is unclear to what extent the results can be generalized to other subgroups of youth. Associations among various nested contexts and risk behaviors should be explored in other age and racial groups and in other geographic regions.

Despite these limitations, this study demonstrates that an ecological perspective on adolescent behavior provides a rich framework for understanding the joint impact of social contexts and social influences on substance use. As public health representatives, teachers, and psychologists begin to focus on prevention, there must be a commitment to understanding and respecting the social context that influences the lives of adolescents. The findings of the current research are important because they identify specific contextual factors that can be supported with appropriate interventions to promote healthy adolescent development. Adolescents might best benefit from integrative services that simultaneously consider various contexts of development and the complex interrelated needs of adolescents. This study acknowledges the importance of developing protective factors within an adolescent's peer group and family, and in the community and schools. Failure to develop or contribute to these protective factors will most likely lead to negative outcomes for many youth in the future.

Appendix: Items in Each Scale

Peer Influence

1. My friends help me to stay out of trouble.
2. Most of my friends do not have sexual intercourse.
3. Most of my friends do not drink or do drugs.
4. Most of my friends do not smoke cigarettes or chew tobacco.

Parental Communication

How often in the PAST 12 MONTHS have you had a good talk with at least one parent or adult who lives with you about the following issues?

1. The risks of drinking or taking other drugs
2. About sexual values (things like teen sex, birth control, sexually transmitted diseases, etc.)
3. Your personal problems

Parental Knowledge

1. When I go out my parents/guardians know where I'll be and who I'll be with.
2. They usually know what I am doing after school.

Parental Support

1. My parents/guardians are there when I need them.
2. My parents/guardians care about me.

Parental Values

1. My parents/guardians think it is wrong for teens my age to have sexual intercourse.
2. My parent/guardians think it is wrong for teens my age to drink alcohol.
3. My parent/guardians think it is wrong for teens my age to smoke/chew tobacco.
4. My parent/guardians think it is wrong for teens my age to smoke marijuana.

School Climate

1. Students in my school are typically asked to help set rules and solve problems.
2. Kids sometimes treat me unfairly because of my race or ethnicity.
3. The rules at my school are enforced fairly most of the time.
4. I am getting the education and skills I need to be successful after I graduate from high school.
5. Generally, the adults in my school respect my opinion.
6. I believe I am getting a good education at my school.
7. I usually enjoy going to school.
8. Adults in my school care about me and how well I do in school.

Sense of Community

1. Generally, my neighborhood is a safe place to live.
2. Most adults in my community keep an eye on what teens are up to.
3. If I had a problem, there are neighbors I could count on to help me.
4. Most people in my community know and care about each other.
5. Usually I can count on the police if I am having a problem or need help.
6. In my neighborhood, away from school, people sometimes treat me unfairly because of my race or ethnicity.

References

- Bond, L., Butler, H., & Thomas, L. (2007). Social and school connectedness in early secondary school as predictors of late teenage substance use, mental health, and academic outcomes. *Journal of Adolescent Health, 40*, 9–18.
- Breyers, J. M., Bates, J. E., Pettit, G. S., & Dodge, K. A. (2003). Neighborhood structure, parenting processes, and the development of youths' externalizing behaviors: A multilevel analysis. *American Journal of Community Psychology, 31*, 35–53.
- Bronfenbrenner, U. (1977). Toward an experimental ecology of human development. *American Psychologist, 32*, 513–531.
- Bronfenbrenner, U. (1979). *The ecology of human development*. Cambridge, MA: Harvard University Press.
- Brown, S. A., Aarons, G. A., & Abrantes, A. M. (2001). Adolescent alcohol and drug abuse. In C. E. Walker & M. C. Roberts (Eds.), *Handbook of clinical child psychology* (3rd ed.). New York: Wiley.
- Bryk, A. S., Raudenbush, S. W., & Congdon, R. T. (1996). *HLM. Hierarchical linear and nonlinear modeling with the HLM/2L and HLM/3L programs*. Chicago, IL: Scientific Software International.
- Chassin, L., Presson, C., Todd, M., Rose, J., & Sherman, S. J. (1998). Maternal socialization of adolescent smoking: The intergenerational transmission of parenting and smoking. *Developmental Psychology, 34*, 1189–1201.
- Cleveland, M. J., Gibbons, F. X., Gerrard, M., Pmery, E. A., & Brody, G. H. (2005). The impact of parenting on risk cognitions and risk behavior: A study of mediation and moderation in a panel of African American adolescents. *Child Development, 76*, 900–916.
- Denton, R. E., & Kampfe, C. M. (1994). The relationship between family variables and adolescent substance abuse: A literature review. *Adolescence, 29*, 475–495.
- Dishion, T. J., Eddy, J. M., Haas, E., Li, F., & Spracklen, K. (1997). Friendships and violent behavior during adolescence. *Social Development, 6*, 207–223.
- Dishion, T. J., Nelson, S. E., & Bullock, B. M. (2004). Premature adolescent autonomy: Family management and deviant peer process in the amplification of problem behavior. *Journal of Adolescence, 27*, 515–530.
- Dishion, T. J., & Patterson, G. R. (1997). The timing and severity of antisocial behavior: Three hypotheses within an ecological framework. In D. M. Stoff, J. Breiling, & J. D. Maser (Eds.), *Handbook of antisocial behavior* (pp. 205–217). New York: Wiley.
- Dishion, T. J., Patterson, G. R., & Reid, J. R. (1988). Parent and peer factors associated with drug sampling and early adolescence: Implications for treatment. *National Institute on Drug Abuse: Research Monograph Series, 77*, 69–93.
- Eitle, D. J., & Eitle, T. M. (2004). School and country characteristics as predictors of school rates of substance use incidents. *Journal of Health and Social Behavior, 45*, 408–421.
- Floyd, F. J., & Widaman, K. F. (1995). Factor analysis in the development of refinement of clinical assessment instruments. *Psychological Assessment, 7*, 286–299.
- Goldstein, S. E., Davis-Kean, P. E., & Eccles, J. S. (2005). Parents, peers, and problem behavior. A longitudinal investigation of the impact of relationship perceptions and characteristics on the development of adolescent problem behavior. *Developmental Psychology, 41*, 401–413.
- Gottfredson, M. R., & Hirschi, T. (1990). *A general theory of crime*. Stanford: Stanford University Press.
- Hawkins, J. D., & Fitzgibbon, J. J. (1993). Risk factors and risk behaviors in prevention of adolescent substance abuse. *Adolescent Medicine: State of the Art Reviews, 4*, 249–262.
- Hawkins, J. D., Lee Van Horn, M., & Arthur, M. W. (2004). Community variation in risk and protective factors and substance use outcomes. *Prevention Science, 5*, 213–220.
- Jencks, C., & Mayer, S. (1990). The social consequences of growing up in a poor neighborhood. In L. E. Lynn & M. F. H. McGeary (Eds.), *Inner-city poverty in the United States* (pp. 111–186). Washington, DC: National Academy Press.
- Jessor, R. (1993). Successful adolescent development among youth in high-risk settings. *American Psychologist, 48*, 117–126.
- Jöreskog, K. G., & Sörbom, D. (1998). *Lisrel 8: Structural equation modeling with the Simplis command language*. Mahwah, NJ: Erlbaum.

- Kerr, M., & Stattin, H. (2000). What parents know, how they know it, and several forms of adolescent adjustment: Further support for a reinterpretation of monitoring. *Developmental Psychology, 36*, 366–380.
- Koenig, B., Espelage, D., & Biedndseil, R. (2005). *The Dane county youth assessment*. Unpublished Report: The Dane County Youth Commission.
- Leventhal, T., & Brooks-Gunn, J. (2000). The neighborhoods they live in: The effects of neighborhood residence on child and adolescent outcomes. *Psychological Bulletin, 126*, 309–337.
- Marta, E. (1997). Parent-adolescent interactions and psychosocial risk in adolescents: An analysis of communication, support, and gender. *Journal of Adolescence, 20*, 473–487.
- Metzler, C. W., Noell, J., Biglan, A., Ary, D., & Smolkowski, K. (1994). The social context for risky sexual behavior among adolescents. *Journal of Behavioral Medicine, 17*, 419–438.
- National Institute on Alcohol Abuse and Alcoholism. (2007). Found on March 17, http://www.surgeongeneral.gov/topics/underage_drinking.
- NIDA. (2008). Found on March 23, http://www.nida.nih.gov/med_staff.html.
- Patterson, G. R., Dishion, T. J., & Yoerger, K. (2000). Adolescent growth in new forms of problem behavior: Macro- and micro-peer dynamics. *Prevention Science, 1*, 3–13.
- Pettit, G. S., Bates, J. E., Dodge, K. A., & Meece, D. W. (1999). The impact of after-school peer contact on early adolescent externalizing problems is moderated by parental monitoring, perceived neighborhood safety, and prior adjustment. *Child Development, 70*, 768–778.
- Raudenbush, S. W., & Bryk, A. S. (2002). *Hierarchical linear models: Applications and data analysis methods* (2nd ed.). Newbury Park, CA: Sage.
- Sampson, R. J. (1997). Collective regulation of adolescent misbehavior: Validation results from eighty Chicago neighborhoods. *Journal of Adolescent Research, 12*, 227–244.
- Sampson, R. J., Raudenbush, S. W., & Earls, S. (1997). Neighborhoods and violent crime: A multilevel study of collective efficacy. *Science, 277*, 918–924.
- Shaw, C. R., & McKay, H. D. (1942). *Juvenile delinquency and urban areas*. Chicago: The University of Chicago Press.
- Thompson, W. E., Mitchell, J., & Doddler, R. A. (1984). An empirical test of Hirschi's control theory of delinquency. *Deviant Behavior, 5*, 11–22.
- Wagner, E. F., & Waldron, H. B. (2001). *Innovations in adolescent substance abuse interventions* (pp. 189–203). New York: Pergamon Press, Elsevier Science.
- Wallace, J. M., Yamaguchi, R., Bachman, J. G., O'Malley, P. M., Schulenberg, J. E., & Johnston, L. D. (2007). Religiosity and adolescent substance use: The role of individual and contextual influences. *Social Problems, 54*, 308–327.
- Warr, M. (2002). *Companions in crime: The social aspects of criminal conduct*. Cambridge: Cambridge Press.
- Wilson, W. J. (1987). *The truly disadvantaged: The inner city, the underclass, and public policy*. Chicago: University of Chicago Press.
- Zapert, K., Snow, D. L., & Tebes, J. K. (2002). Patterns of substance use in early through late adolescence. *American Journal of Community Psychology, 30*, 835–852.

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