Published in final edited form as:
J Youth Adolesc. 2010 February ; 39(2): 114–126. doi:10.1007/s10964-009-9395-y.

Protective Families in High- and Low-Risk Environments:

Implications for Adolescent Substance Use

Michael J. Cleveland, Ph.D.[1,2], **Mark E. Feinberg, Ph.D.**[1], and **Mark T. Greenberg, Ph.D.**[1,3]

[1]The Prevention Research Center, The Pennsylvania State University

[2]The Methodology Center, The Pennsylvania State University

[3]Department of Human Development and Family Studies, The Pennsylvania State University

Abstract

This study used data from a sample of 6th through 12th grade students (*N* = 48,641, 51% female), nested in 192 schools, to determine if the influence of family-based protective factors varied across different school contexts. Hierarchical logistic regression models were used to examine the effects of individual-level family protective factors, relative to school-level aggregates of the same factors, on recent (past 30-day) use of cigarettes, alcohol, and marijuana. Cross-level interactions indicated that the effect of the student's level of family protection, relative to other students in their school, differed depending on the aggregated school level of family protection. The results suggested that the benefit of belonging to a well-functioning family was more influential for students attending schools characterized by higher-than-average aggregated levels of protection compared to students attending schools of lower-than-average protection. Thus, family-level factors offered less protection for students in relatively high-risk school contexts. These results were consistent with a protective-reactive interaction and suggest that a thorough understanding of adolescent substance use must consider the complex interplay among adolescents, their families, and their social environments.

Keywords

context; family; adolescent substance use; moderated effects; multilevel

Introduction

National epidemiologic surveys indicate that over the past several years, rates of alcohol, tobacco, and other drug (ATOD) use among U.S. youth have declined since reaching recent peak levels in the mid-1990's (Johnston, O'Malley, Bachman, & Schulenberg, 2008). However, this positive trend obscures some important facts about U.S. teens' ATOD use. First, it remains troubling that, by senior year of high school, nearly three quarters (72.2%) of American youth have tried alcohol and nearly half (46.2%) have used cigarettes. There is also evidence that rates of use have declined less among younger adolescents compared to their older peers (Johnston, O'Malley, Bachman, & Schulenberg, 2007). Moreover, important subgroup differences in these rates continue to exist (Richards, Miller, O'Donnell, Wasserman, & Colder, 2004). Across ethnic groups, boys and older adolescents generally report higher levels of ATOD use (Wallace et al., 2003). Highest rates of ATOD use have been reported for American Indian youth, followed by White and African American adolescents, Hispanic youth, and Asian American teens, respectively (Substance Abuse and Mental Health Services

Corresponding Author: Michael J. Cleveland, The Methodology Center, 204 E. Calder Way, Suite 400, State College, PA 16801, Email: mjc37@psu.edu, Phone: 814-867-0333.

Administration, 2007). These statistics underscore the continued need for effective prevention and intervention efforts to ameliorate the harmful short- and long-term consequences of adolescent ATOD use.

The development of effective interventions depends on a clear understanding of risk and protective factors that are associated with adolescents' ATOD use. There is a general consensus across disciplines that the etiology of ATOD use is multifactorial and involves complex interactions among genetic, psychological, and social determinants (Galea, Nandi, & Vlahov, 2004; Masten, Faden, Zucker, & Spear, 2008). Thus, predictors of adolescents' ATOD use occur at multiple levels of the ecology - both in the adolescent and in the various contexts in which adolescents find themselves (e.g., peer groups, schools, communities). However, despite this understanding, research on adolescents' ATOD use has typically focused on individual risk factors (Compton, Thomas, Conway, & Colliver, 2005; Thomas, 2008). Only rarely have studies included interactions among two or more social contexts (Ennett et al., 2008).

The current study addresses this concern by focusing on two of these contexts: the family and school. According to Bronfenbrenner (1977), these microsystems (along with peer context) are the most immediate and principal contexts of adolescent development. Recent studies have noted the primacy of the family context in predicting adolescents' ATOD use, concluding that this predominance endures throughout adolescence (Ennett et al., 2008). Therefore, our primary aim was to examine how family protective factors influence adolescents' ATOD use. We were especially interested in determining whether the influence of family-level protective factors varied across different school contexts.

Relating Adolescents' ATOD Use to Family and School Contexts

Several specific aspects of the family environment have been found to be particularly important protective factors for adolescents' ATOD use. First, adolescents fare better when their parents employ an authoritative parenting style (Baumrind, 1991), characterized by warmth and support combined with rules and control (Steinberg, 2001). Specifically, adolescents raised by parents who use consistent disciplinary techniques and monitor their children's activities are less likely to engage in risk behavior (Capaldi & Patterson, 1996; Li, Stanton, & Feigelman, 2000; Leventhal & Brooks-Gunn, 2000). A substantial body of literature also has found that provision of warmth and support by parents is associated with less adolescent substance use (Barnes, Reifman, Farrell, & Dintcheff, 2000; Galambos, Barker, & Almeida, 2003; Scheier, 2001; Windle, 2000). Furthermore, adolescents who spend a lot of time with their parents and who talk openly with their parents are less likely to use alcohol and other substances (Crawford & Novak, 2002; Kuendig & Kuntsche, 2006; Stattin & Kerr, 2000).

Previous research also has established that adolescents' ATOD use is linked to the school context and that substance use rates vary across schools (Ennett, Flewelling, Lindrooth, & Norton, 1997; Kumar, O'Malley, Johnston, Schulenberg, & Bachman, 2002; O'Malley, Johnston, Bachman, Schulenberg, & Kumar, 2006). School contexts also vary in the overall level of risk and protective factors for adolescents' ATOD use (Ashby, 1995; Battistich & Horn, 1997; Rountree & Clayton, 1999). These school-level differences may reflect sociodemographic characteristics, which are important determinants of adolescents' ATOD use and other health risk behaviors (Leventhal & Brooks-Gunn, 2000; Sampson, Morenoff, & Gannon-Rowley, 2002). U.S. adolescents spend a large percentage of their waking hours at school, both in the classroom and in out-of-class activities (Larson & Verma, 1999). Therefore, it is not surprising that the school-level normative environment is also an important predictor of adolescent outcomes (Ennett et al., 1997; Henry & Slater, 2007; Kumar et al., 2002). For example, one recent study demonstrated that aggregated school-level normative perceptions contributed to the prediction of adolescent marijuana use, over and above the individual student's level of perceived norms (Swaim, 2003). Despite this evidence that the school context

matters, much work remains to be done in order to understand how adolescent ATOD use is shaped by contextual factors such as school-level norms. In particular, research is needed that examines multiple contexts such as family and school environments (Ennett et al., 2008).

Interactions between Family and School Contexts

There is evidence that family, school, and other social contexts do not operate in isolation but rather that there is some interplay among them that influences adolescent risk behaviors (Kumar et al., 2002; Swaim, 2003). The common belief is that such cross-level interactions operate in what Luthar and colleagues describe as a *protective-enhancing effect* whereby the influence of protective factors on "competence is augmented with increasing risk" (Luthar, Cicchetti, & Becker, 2000, p. 547). In this case, living in a well-functioning family offers strong protection against negative outcomes for adolescents residing in contexts characterized by high risk (e.g., Beyers, Loeber, Wickstrom, & Stouthamer-Loeber, 2001; Plybon and Kliewer, 2001). In other words, family factors, such as nurturant parenting, provision of warmth, and consistent disciplinary practices, can act as protective buffers against the negative impact of a high-risk context. The emphasis in this perspective is on the presence or absence of protective processes in the family environment that moderate the negative influence of the contextual environment. When such processes are present in the family, a compensating effect occurs such that the impact of protective family factors is amplified (e.g., parental monitoring has a stronger effect in high-risk contexts). This type of moderation also has been referred to as the *buffering hypothesis* (Lin & Ensel, 1989) to reflect this compensatory effect.

A recent review of literature examined whether risk factors for child conduct problems varied in their importance across types of contextual environments (Schonberg & Shaw, 2007). These authors found that 44 studies reported significant interactions between proximal familial factors and contextual risk. Among these studies, family protective factors were generally found to be more influential in high-risk contexts, a finding consistent with the buffering hypothesis. However, Schonberg and Shaw (2007) noted that only one specific family protective factor—parental supervision—was included in more than two studies and was consistently found to vary in importance across contextual conditions. Most of these studies (8 out of 11) found that high levels of supervision were more protective against conduct problems in the context of high contextual risk. How other aspects of positive family functioning and contextual risk factors interact remains relatively unknown.

Schonberg and Shaw (2007) also noted that several studies reported findings inconsistent with the buffering hypothesis, suggesting that protective family factors were less influential in high-risk contexts. According to Luthar et al.'s (2000) scheme, such findings reflect a *protective-reactive effect* whereby the "attribute generally confers advantages but less so when stress levels are high than low" (p. 547). Thus, the beneficial influence of proximal social resources is less powerful under adverse contextual conditions than in optimal contexts. In other words, the protective aspects of one's family situation may become overpowered by the influence of high-risk contextual conditions. In this case, factors that appear protective in conditions of low risk may not reduce the vulnerability for negative outcomes in conditions of high risk. It may be that highly adverse contexts overwhelm the possible benefits of these protective factors (e.g., nurturing-involved parenting practices or parent-adolescent closeness) such that these protective effects are visible only under less adverse conditions. Alternatively, these nonlinear effects suggest that contextual-level factors matter the most when reinforced by one's own family functioning such that the impact of protective family influences is enhanced when the family resides in low-risk contexts.

Importantly, most of the findings that supported the protective-reactive effect were found in studies that focused on the use of physical discipline, a factor that may vary in importance across racial and ethnic groups, or only compared children across high-risk and extremely high-

risk environments (Schonberg & Shaw, 2007). Future research across a full range of familial protective factors and socio-economic contexts is needed to clarify how family factors reliably interact with contextual risk. Furthermore, the review by Schonberg and Shaw (2007) was limited to studies of child conduct problems, explicitly excluding studies that examined other developmental outcomes.

This exclusion is noteworthy because recent studies have examined the role of family and contextual factors on a range of other adolescent behaviors. Many of these studies concluded that the influence of protective family factors is stronger in less adverse contexts, providing evidence of a protective-reactive effect. For example, several authors found that familial factors that appeared protective in low-risk contexts failed to reduce vulnerability for depressive and anxiety symptoms in conditions of high risk (Hammack et al., 2004; Wickrama & Bryant, 2003; Wickrama, Noh, & Bryant, 2005; Wight, Botticello, & Aneshensel, 2006). Other research has found evidence of protective-reactive effects when examining externalizing problems including delinquency (Butler, Fearon, Atkinson, & Parker, 2007; Simons, Simons, Burt, Brody, & Cutrona, 2005) and youth violence (Knoester & Haynie, 2005).

Very few studies have tested the moderation between proximal and contextual factors with an eye toward developmental differences. One exception is Fitzpatrick (1997) who found support for the buffering hypothesis only among middle school students and not elementary or high school students. There is general consensus that family influences recede in middle and late adolescence as youth spend more unsupervised time with peers (Furman & Buhrmester, 1992). In fact, other research with the same sample as the current study indicated that adolescent-reported family and neighborhood factors were more salient for younger cohorts whereas adolescents' perceptions of peer and school factors were more important for older adolescents (Cleveland, Feinberg, Bontempo, & Greenberg, 2008).

The Current Study

The nature of the interaction between familial- and contextual-level factors on adolescent outcomes appears to be complex. Previous research suggests that different conclusions regarding cross-level interactions may be drawn depending on several factors: the specific protective parenting behavior (e.g., supervision vs. disciplinary style), the adolescent outcome (e.g., conduct problems, internalizing behavior, or delinquency), or the age of the child. The present study was designed to contribute to this literature in three ways. First, we focused on adolescent substance use, an outcome that has received little attention in studies of familial- and contextual-level moderation. Additionally, we incorporated a comprehensive measure of family protective factors that allowed the potential to clarify specific effects for different types of parenting behaviors. Finally, little research has been conducted with large enough samples of children to examine age differences in cross-level moderating effects. The current study includes adolescents from four age cohorts across sixth, eighth, tenth, and twelfth grades.

In this study, we employed hierarchical modeling techniques to examine how family protective processes are associated with adolescents' ATOD use and how these relations may vary across school contexts. We conceptualized the family and school contexts as multilevel units of analysis. That is, individual adolescent's observations of parenting behaviors comprised the family-level and these observations were nested within the school-level units. The perceptions from adolescents were aggregated at the school-level to provide a measure of the school context.

We hypothesized that family protective processes at both the family- and the aggregated school-level would be positively associated with increased ATOD use. Based on previous research examining cross-level interactions between family and other contexts (e.g., Butler et al., 2007; Knoester & Haynie, 2005; Simons et al., 2005), we also hypothesized that the

association between family-level protection and adolescents' ATOD use would be strongest in school contexts characterized by low risk. That is, we expected to find support for a protective-reactive effect. We also explored how specific parenting behaviors would influence adolescents' ATOD use. However, given the limited amount of research that has examined these types of effects (Schonberg & Shaw, 2007), no specific hypotheses were put forth. Finally, although age group differences in these relations were explored, the paucity of previous research in this area precluded specific hypotheses from being formulated.

Method

Procedure

The data come from the 2005 Pennsylvania Youth Survey (PAYS) dataset. PAYS is a biennial state-funded surveillance survey with a representative sample of public and private school districts, and involves all sixth, eighth, tenth, and twelfth grade students in those districts. The current study does not include representation from the state's two major metropolitan regions, Philadelphia and Pittsburgh. Schools were divided into six regions of the state, and for each of the four targeted grades in each region, a separate random sample was drawn. Each school's grade was assigned a likelihood of participation equivalent to the proportion of the regional student population comprised by the school's grade. Additional schools volunteered to participate in the survey to monitor risks and problems in their own community.

Participants

The full sample included 93,884 students from 320 schools in 177 school districts. As school officials were given the option to exclude items related to family risk and protective domains from the student surveys, 69 (38.98%) of the 177 school districts did so and are excluded from these analyses. The participating school districts had an average of 7.3% of households below the poverty line (range 1.4% to 18.4%) and an average of 23.1% single-parent headed households (range 7.7% - 50.5%). Apart from two major metropolitan regions, Pennsylvania is largely rural or semi-rural and white. For example, Pennsylvania has the largest rural population of any state in the U.S., and non-white students comprise 13.7% of the student population. The characteristics of our sample, which did not include representation from the state's two major metropolitan regions, reflect this overall demographic profile: The average population of the school districts was 20,673 (range 2576 to 103,717). Although many of the school districts in the rural and small town areas were predominantly white, some areas had predominant minority populations. The average percentage for non-whites in the participating districts was 8.78 (range 0% to 85.39%), and the average percent Hispanic was 2.65 (range 0% to 31.57%). There were no significant differences between the participating and non-participating school districts among any of these demographic measures.

The current study used the sample of 48,641 students (51% female) from the targeted grades (6, 8, 10, and 12), and from which both family and school-level information was available. Most (83.16%) of the students were white; 8.30% identified as African American and 7.43% indicated that they were of Latino origin. These students were nested in 192 different schools. The average cluster size within schools was 253 students. The surveys were group-administered during one classroom period and students were asked to complete the survey but were also told that participation was voluntary. Passive parent consent was utilized, and all responses were anonymous in order to foster honest responses.

Measures

Family Protection—PAYS utilizes the Communities That Care Youth Survey (CTC-YS), a broad assessment of risk and protective factors as well as problem behaviors (Arthur, Hawkins, Pollard, Catalano, & Baglioni, 2002). An earlier study demonstrated that aggregate

indices of the 31 scales in the CTC-YS provided meaningful and useful measures of adolescent risk and protective factors (Feinberg, Ridenour, & Greenberg, 2007). The current study used the aggregate index that tapped into five specific indices of protective family factors. The five indices were first standardized and then aggregated to provide an overall measure of family protection.

Attachment: Adolescents' perceptions of family attachment were measured with four items that assessed adolescents' feelings of closeness and disclosure of feelings with both parents. Adolescents were asked to respond on a 4-point scale (1 = NO! to 4 = YES!) to two questions regarding each parent: "Do you feel very close to your [mother / father]?" and "Do you share your thoughts and feelings with your [mother / father]?" The standardized scale scores were averaged across both parents. Chronbach's alpha was 0.78.

Opportunities for prosocial involvement: Three items were used to measure adolescents' perceptions of family opportunities for prosocial involvement (e.g., "My parents give me lots of chances to do fun things with them"). The responses were measured on a 4-point scale (1 = NO! to 4 = YES!), which were standardized and averaged to provide an index of prosocial opportunities in the family. Chronbach's alpha for the scale was 0.79.

Rewards for prosocial involvement: Adolescents responded to four items that ascertained perceived rewards for prosocial involvement in their family. These items included "My parents notice when I am doing a good job and let me know about it" and "How often do your parents tell you they're proud of you for something you've done," both measured on a 4-point scale (1 = never or almost never to 4 = all the time). Adolescents also responded to two items that concerned their enjoyment of spending time with each parent: "Do you enjoy spending time with your [mother / father]," measured on a 4-point scale (1 = NO! to 4 = YES!). The standardized scores of the four items were averaged. Chronbach's alpha for the scale was 0.79.

Supervision: Adolescents' perceptions of family supervision were assessed by averaging the scores of four items that referred to their parents' use of supervisory and monitoring behaviors. Sample items include "If you skipped school, would you be caught by your parents?" and "When I am not at home, one of my parents knows where I am and who I am with." The items were measured on a 4-point scale (1 = NO! to 4 = YES!), which were standardized and then aggregated. Chronbach's alpha for the index was 0.80.

Discipline: Three items tapped into adolescents' perceptions of their family disciplinary practices. These items reflect the parents' use of clear and consistent rules (e.g., "The rules in my family are clear") and each were measured on a 4-point scale (1 = NO! to 4 = YES!). Chronbach's alpha for the standardized index was 0.78.

Adolescents' ATOD use—To assess ATOD use, the students were asked to respond to three items corresponding to recent use of cigarettes, alcohol, and marijuana. Recent cigarette use was ascertained by the item, "How frequently have you smoked cigarettes during the past 30 days?" Seven response categories were available for this item, ranging from *not at all* to *two packs or more per day*. Recent use of alcohol was assessed by asking "On how many occasions (if any) have you had beer, wine, or hard liquor during the past 30 days?" Recent marijuana use was assessed using the same stem as the alcohol measure, followed by "used marijuana during the past 30 days." Both items had seven response categories that ranged between *0* to *40+ occasions*.

Analysis Plan—Traditional hierarchical linear models assume the outcome variable is measured on a continuous scale and is normally distributed. However, our substance use

outcomes were measured on ordinal scales, with the modal values of zero for all substance types across all four grade levels. In addition, our data had a clustered structure, consisting of students who were nested in schools. Therefore, we used hierarchical nonlinear generalized models for our analysis. Specifically, we estimated hierarchical logistic regression models using SAS Proc Glimmix (Schabenberger, 2005). The outcome variable in logistic regression is dichotomous such as an adolescent does or does not report substance use in the previous 30 days. Thus, the dependent variable can take the value of 1 with a probability of success θ, or the value 0 with probability of failure 1-θ. The relationship between the outcome and predictor variables is not a linear function in logistic regression; instead the logit transformation of θ is modeled as a linear function of the predictor variables. The logistic regression equation is specified as follows:

$$\text{logit}\,[\theta(x)] = \log\left[\frac{\theta(x)}{1-\theta(x)}\right] = \alpha + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_i x_i$$

The parameter estimates of logistic regression are the probability of success (θ) over the probability of failure (1-θ). Odds ratios (ORs) are the exponentiation of the estimated coefficients and can be interpreted as the increase in the odds of belonging to one outcome category (e.g., use of alcohol in previous 30 days) when the value of the predictor variable increases by one unit. ORs greater than 1 correspond to increasing odds of an outcome having a value of "1"; ORs less than 1 indicate the odds of success (outcome variable = "1") decrease with a one-unit change in the predictor variable.

Separate hierarchical logistic regression models with level-1 (family-level) and level-2 (aggregated school-level) predictors, and their cross-level interaction, were estimated separately for each substance use outcome. At level 1, each student's reported level of family protection was centered about its respective school mean (i.e., group-mean centered). This measure provided an indication of the particular student's deviation from the school norm (e.g., the student resides in a family with relatively low protection compared to other students in the school). Level-2 factors were created by aggregating reported family protective factors within each school and centered around their respective grand means. Thus, the level-2 variable provided an indication of family protection across the different schools. All models controlled for school-level SES (the proportion of students in the school district that were eligible for free lunch) and student gender. Preliminary models indicated that significant two- and three-way interactions between grade level and the family- and/or school-level variables were present for most outcomes. Therefore, separate models were conducted for each grade level.

Results

One-way ANOVA Models

The percent of students in each grade who reported recent use of cigarettes, alcohol, or marijuana are presented in Figure 1. Very few 6th grade students reported use of any substance: less than 2% reported using cigarettes or marijuana in the previous 30 days and only 4% reported recent alcohol use. As expected, substance use increased with age and rates were highest among the 12th grade students, of whom more than 20% reported recent cigarette or marijuana use and more than half reported more than one instance of drinking in the previous 30 days. Descriptive statistics for the predictor variables at the individual family-level and the aggregated school-level are presented in Table 1 and bivariate correlations among the study variables are presented in Table 2. The ATOD use variables were moderately correlated with each other (*r*s range from 0.45 to 0.50; all *p*s < .001). All of the predictor variables were significantly associated with each substance use outcome (all *p*s < .001).

To estimate the effect of family protective factors on ATOD use, we first estimated one-way analysis of variance (ANOVA) models to provide preliminary information about the amount of variation in the substance use outcomes and family protective factors that could be attributed to within- and between-school clusters. This information was used to calculate the intraclass correlation (ICC), which represents the proportion of variance between school clusters. Standard hierarchical linear models were used in this step due to evidence that suggests that the level-1 variance is heteroscedastic in models with nonlinear link functions, limiting the usefulness of such models to calculate ICC values (Raudenbush & Bryk, 2002). For substance use, 6% of the variability in recent cigarette use, 10% of the variability in recent alcohol use, and 4% of the variability in recent marijuana use was between schools. ICC values for the family protective factor index indicated that 17% of the variability in these processes was between schools.

Hierarchical Logistic Regression Models

Next, separate hierarchical logistic regression models were estimated for each substance use outcome and grade level. All models included student gender and school-level SES (defined as the percentage of families in the school district eligible for free lunch) entered first as controls, followed by school-level variables, family-level variables, and the cross-level interactions between school- and family-level variables. The results of the models are presented in Table 3.

In the models for students in grade 6, the main effect of protective factors at the family-level was a significant predictor of all three substances. In each case, greater levels of family protection corresponded to decreased odds of use (all ORs < 1.0, $p < .01$). For students in grade 8, both family-level and the aggregated school-level protection were significantly associated with decreased odds of substance use (all ps < .05). The cross-level interaction term was not significant for either of these younger age groups. However, among the students in grade 10, and two out of the three models for 12th grade students, the interaction between family-level protection and school-level protection was significant (all ps < .05). These results suggested that the magnitude of the effect of family-level protective factors, relative to other students in their school, differed depending on the aggregated school levels of family protection.

To better understand the nature of these interactions, we plotted the results of the three substance use models for grade 10 students in Figure 2. The figure displays the effects (i.e., odds ratios) of family-level protection across three levels of aggregated school-level protective factors (low, average, and high as defined by +/-1 SD about the grand mean of school-level family protection). As the figure shows, the effect of family-level protection varied across the level of school-level protection. At high levels of school-level protection, family-level protection was related to decreased odds of ATOD use. However, at low levels of school-level protection, family-level factors did not protect against ATOD use (i.e., OR > 1.0). The direction of these interactions suggested a protective-reactive effect such that individual-level family factors were least important when the students' school was characterized by lower-than-average protection.

We also performed separate regression analyses of family protection on recent alcohol use for low- and high-protection schools. The two levels of protection correspond to schools one standard deviation below ($N = 7$) or above the mean ($N = 33$) on school-level family protection. For these analyses, all students from grades 6-12 were used and sex and age were controlled. The results indicated that when school-level family protection was high, the effect of family-level protection was significant ($\beta = -0.86$, $t = 14.11$); however, when school-level family protection was low, the effect of family-level protection was non-significant ($\beta = 0.69$, $t = 0.91$). Similar results were found when models predicting recent cigarette or marijuana use were estimated.

Effects of Specific Family Factors

The results of the above models showed consistent results regarding the nature of the cross-level interaction term between family- and school-level protective factors. Though varying in magnitude, all significant interaction terms were negative, indicating that the relation between family-level factors and substance use outcomes was stronger in schools characterized by families with high levels of protection (i.e., high-functioning schools). In the next step the family protective factors were disaggregated to explore the nature of the cross-level interaction for specific family processes.

The coefficients of the cross-level interaction terms for these models are presented in Table 4. Consistent with earlier results, significant interaction effects were found for use of all three substances among the older two grades, particularly for parental use of supervision and disciplinary techniques. Furthermore, among the 10^{th} grade students, the cross-level interaction term for parental rewards for prosocial behavior was significant for all three substance types. In contrast, the cross-level interaction term for opportunities for prosocial behavior was significant only among 10^{th} grade students' cigarette use. Less consistent results were seen among the models predicting use among the students in grades 6 and 8. As before, all of the interactions were in the same direction and indicated that the family process factors were more influential in higher functioning school environments.

Discussion

The results of this research provide evidence that the effects of family processes on adolescents' ATOD use are best understood as embedded in social contexts. Using a large sample of adolescents across four grade levels, we found evidence that individual family-level and school-level aggregates of parental protective factors interacted to predict ATOD use outcomes, particularly among the 10^{th} and 12^{th} grade students. In general, the models predicting cigarette, alcohol, and marijuana use showed similar patterns both within and across the four grade cohorts. For example, among students in grade 6, the only significant predictor of use, regardless of type of substance, was the family-level protective factors. Similarly, the cross-level interaction term was significant in all models predicting 10^{th} grade ATOD use, regardless of substance type.

The nature of the cross-level interaction consistently indicated that the benefit of belonging to a well-functioning family, relative to others in your school, was more influential for students attending schools characterized by higher-than-average aggregate levels of protection compared to students attending schools of lower-than-average protection. Furthermore, we examined the effects of specific family protective factors. Our results suggested that parents' supervision practices and disciplinary techniques had relatively greater influence on adolescents' ATOD use when their child attended a school characterized by well-functioning families. These parenting behaviors are well-established predictors of adolescent risk behaviors (Capaldi & Patterson, 1996; Li, Stanton, & Feigelman, 2000; Leventhal & Brooks-Gunn, 2000). Thus, the finding that students in schools in which few families show high rates of supervision or disciplinary practices show higher drug use (even if their own family is assessed as high in protection) is noteworthy. Some evidence that other family-level parental processes are moderated by school-level protection was also seen for family opportunities and rewards for prosocial involvement; however, these results were less consistent across the four grades.

Cross-Level Moderation of Family- and School-Level Protection

It is useful to place the current results in the context of resilience as defined by Luthar et al. (2000). Our results suggested that family and school-level factors interacted in a *protective-reactive* manner such that the effects of family protective factors (e.g., parental supervision

and discipline) on adolescents' ATOD use were strongest in favorable school contexts. This can be contrasted with a buffering process where the deterrent effect of the protective factor is strongest under less favorable contextual circumstances. Past research has found support for the buffering hypothesis when examining externalizing behaviors such as conduct disorder (Schonberg & Shaw, 2007). However, other studies have suggested that cross-level interactions operate in a protective-reactive manner when predicting adolescent depression and anxiety (Hammack et al., 2004; Wickrama et al., 2005; Wickrama & Bryant, 2003; Wight et al., 2006) or less severe delinquent behaviors (Butler et al., 2007; Gorman-Smith, Tolan, & Henry, 2000; Knoester & Haynie, 2005; Simons et al., 2005). A strength of the current study is its large size and the number of communities studied, 177 school districts.

The current results extend the research on cross-level interactions to include ATOD use, which may be viewed as a normative behavior among United States youth. For instance, most high school seniors have tried alcohol at least once in their lives and almost half have used marijuana (Johnston et al., 2008). Our results suggest that authoritative parenting processes, such as supervision and consistent disciplinary practices, are less effective at decreasing the risk of adolescents' ATOD use in certain high-risk contexts. This may indicate that processes outside of the family may overwhelm the deterrent effects of authoritative parenting behaviors. Peer influence is likely one such factor, particularly in regard to adolescent substance use. Affiliation with antisocial peers is one of the strongest predictors of adolescent substance use (Allen, Donohue, Griffin, Ryan, & Mitchell Turner, 2003) and it may be that peer influence is sufficiently strong in certain contexts that parental protective processes are less effective in these circumstances.

Although several studies have suggested that peers may play a more important role in adolescents' ATOD use than parents (e.g., Beal, Ausiello, & Perrin, 2001; Li, Pentz, & Chou, 2002), more recent research has found that family factors such as parental supervision and closeness remained the primary determinants of ATOD use across adolescence (Ennett et al., 2008). There is also strong evidence that parenting style is linked to the types of friends that adolescents associate with, further protecting their child from engaging in ATOD use (Mounts, 2002). Most likely, it is the interaction of parental and peer influences that best predicts adolescent outcomes (Simons-Morton, 2002). An important next step for future research is to examine how interactions among multiple contexts (e.g., parents, peers, schools, neighborhoods) influence ATOD use and other adolescent problem behaviors.

Developmental Differences in Family Protection Influences

There is evidence that relations between risk and protective factors and ATOD outcomes may vary across adolescence (Cleveland et al., 2008). We found several developmental differences in the pattern of associations between protective factors and ATOD use. Family-level protection had a significant impact on use among the 6^{th} grade students, whereas both family-level and school-level protection emerged as important predictors of 8^{th} grade students' ATOD use. Among the older students, family- and school-level significantly interacted to predict alcohol and marijuana use for both 10^{th} and 12 grade students as well as 10^{th} grade students' cigarette use. No significant interactions between family-level and school-level protection were found in the models predicting 6^{th} or 8^{th} grade students' ATOD use.

The strongest associations between protective factors and ATOD use were found for the students in grade 10, particularly for the cross-level interaction term. This particular period of adolescence may be characterized by the transition from dependence on parents for transportation and participation in activities to a more independent lifestyle, as well as by substantial escalation in substance use from prior levels. Developmental theories support the notion that family factors are more influential in childhood and early adolescence (Furman & Buhrmester, 1992). However, our results suggest that adolescents at this stage are particularly

sensitive to the particular *combination* of familial- and contextual-level protection. As the adolescents spend more time outside of their family, it becomes especially critical that parents adjust their supervisory and disciplinary practices to account for this increasing autonomy. We found that these parental control-related factors (i.e., supervision and discipline) emerged as the driving force behind the significant cross-level interaction. This suggests that, at this vulnerable stage, successful parents are those who can balance their child's need for independence while maintaining an authoritative parenting style. Moreover, these results underscore the conclusion that family, peer, school, and neighborhood social contexts are jointly implicated in adolescents' ATOD use (Ennett et al., 2008).

The cross-level interaction can also be interpreted as indicating that authoritative parenting practices are especially effective in a context characterized by other well-functioning families. In fact, other researchers have emphasized this interpretation and refer to an "amplification" process to describe how the deterrent effect of positive parenting practices is enhanced in communities defined by high collective efficacy (Simons et al., 2005). In other words, adolescents fare best when parenting practices in one setting (e.g., the family) are reinforced by supportive control in another setting (Simons et al., 2005). A large literature demonstrates that adolescent risk behavior is associated with a number of community-level factors, such as cohesion among neighbors and residents' willingness to intervene on behalf of their neighbors (Sampson et al., 2002; Tolan, Gorman-Smith, & Henry, 2003; Van Horn, Hawkins, Arthur, & Catalano, 2007). Our results are consistent with these findings and lend further support to the view that adolescents fare best in cohesive communities defined by parents and other adults who look out for each others' kids.

This raises an important question: How can less well-functioning communities move towards a self-reinforcing amplification process? One promising avenue is to implement strategies to strengthen family protective processes by intervening at the school or community level. In particular, our results point to the need to consider multi-component prevention strategies involving both family-based and community-wide programs (Dishion, Kavanagh, Schneiger, Nelson, & Kaufman, 2002; Feinberg, Greenberg, Osgood, Sartorius, & Bontempo, 2007; Lochman & van den Steenhoven, 2002). Family-focused interventions that are implemented in school and community settings represent a cost-effective prevention approach and have been shown to reduce adolescents' ATOD use (Dishion & Kavanagh, 2003; Spoth, Redmond, Shin, Greenberg, & Feinberg, 2007). Our findings suggest that intervening to improve family protective factors at the individual family level may have a beneficial effect on the larger social context - mutually benefitting all families in a school or community. We strongly agree that efforts to bring family-focused interventions to scale have the potential to achieve a significant public health impact and that improving diffusion mechanisms for sustained delivery of quality interventions is among the most important tasks ahead for prevention scientists (Spoth, Kavanaugh, & Dishion, 2002).

The current study had a number of strengths, including a comprehensive measure of parenting behaviors and a large sample of adolescents across several middle and high school grades. We also employed hierarchical modeling techniques that estimated effects for both the individual family level and at an aggregated school level. Past studies have shown that rates of adolescents' ATOD use differ across schools, and that school characteristics, such as school type (e.g., public vs. private), school size, and race/ethnic composition, are associated with school-level ATOD use rates (O'Malley et al., 2006). The exploration of school-level differences in rates of adolescents' ATOD use, and predictors of use, is an important next step in our research agenda. It should also be noted that past studies have used a variety of both structural and process factors to measure other types of contextual effects, including concentration of poverty, violence exposure, family structure, community deviance, and

collective efficacy. We plan to investigate in future studies how such factors may extend the current findings.

It is also important to note that the PAYS sample comprises predominantly non-urban and white students from one state; it is not clear how these results generalize to other geographic areas or to urban or minority youth. There is, however, evidence that racial differences exist among these processes (Schonberg & Shaw, 2007; Wickrama et al., 2005). Other studies have found support for the buffering hypothesis in African American samples (Brody et al., 2003; Cleveland, Gibbons, Gerrard, Pomery, & Brody, 2005; Rankin & Quane, 2002). In view of these results, an important next step for future research is to examine cross-level interactions among different racial, ethnic, and geographic groups as well as across gender. Another limitation of the current study is that the substance use outcomes were dichotomized to reflect any or no use of alcohol, cigarettes, and marijuana. This decision was driven by statistical concerns related to the lack of variability in each outcome, particularly among the younger cohorts. However, care should be taken when interpreting the logistic models in light of evidence that the influence of risk and protective factors may differ depending upon levels of ATOD involvement such as initiation or escalation of use (Dierker, Avenevoli, Goldberg, & Glantz, 2004; Flay, Hu, & Richardson, 1998; Jackson, 1997; van den Bree & Pickworth, 2005).

Conclusion

The current study provides important new information about the complex mechanisms involving the influence of familial and contextual processes on adolescent health risk outcomes. Our results suggest that support for a protective-reactive interaction can be extended to include adolescents' ATOD use. There was strong evidence that this cross-level interaction between the family context and the school context was driven by parents' rewards for prosocial involvement, use of effective supervision, and clear and consistent disciplinary strategies, particularly among the older (10^{th} and 12^{th} grade) cohorts. The observed differences between schools defined by high- and low-risk emphasize the need to implement comprehensive strategies to strengthen family protective processes by intervening at the school or community level.

Acknowledgments

This research was supported by the National Institute on Drug Abuse Center Grant P50 DA100075 to The Methodology Center and NIDA Training Grant T32 DA017629-01A1 to The Prevention Research Center. The PAYS data were made available by a grant from the Pennsylvania Commission on Crime and Delinquency (PCCD). The content is solely the responsibility of the authors and does not necessarily represent the official views of NIDA, NIMH, the National Institutes of Health, or PCCD.

References

Allen M, Donohue WA, Griffin A, Ryan D, Mitchell Turner MM. Comparing the influence of parents and peers on the choice to use drugs: a meta-analytic summary of the literature. Criminal Justice and Behavior 2003;20:163–186.

Arthur MW, Hawkins JD, Pollard JA, Catalano RF, Baglinoi AJ. Measuring risk and protective factors for substance use, delinquency, and other adolescent problem behaviors: the Communities That Care Youth Survey. Evaluation Review 2002;26:575–601. [PubMed: 12465571]

Ashby JS. Impact of contextual variables on adolescent situational expectation of substance use. Journal of Drug Education 1995;25:11–22. [PubMed: 7776146]

Barnes GM, Reifman AS, Farrell MP, Dintcheff BA. The effects of parenting on the development of adolescent alcohol misuse: A six-wave latent growth model. Journal of Marriage and the Family 2000;2000:175–186.

Battistitch V, Horn A. The relationship between students' sense of their school as a community and their involvement in problem behaviors. American Journal of Public Health 1997;87:1997–2001. [PubMed: 9431290]

Baumrind D. The influence of parenting style on adolescent competence and substance use. Journal of Early Adolescence 1991;11:56–95.

Beal AC, Ausiello J, Perrin JM. Social influences on health risk behaviors among minority middle school students. Journal of Adolescent Health 2001;28:474–480. [PubMed: 11377991]

Beyers JM, Loeber R, Wickstrom PH, Stouthamer-Loeber M. What predicts violent delinquency in better-off neighborhoods? Journal of Abnormal Child Psychology 2001;29:369–381. [PubMed: 11695540]

Brody GH, Murry VM, Ge X, Kim SY, Simons RL, Gibbons FX, et al. Neighborhood disadvantage moderates associations of parenting and older sibling problem attitudes and behavior with conduct disorders in African American children. Journal of Consulting and Clinical Psychology 2003;71:211–222. [PubMed: 12699016]

Bronfenbrenner U. Toward an experimental ecology of human development. American Psychologist 1977;7:513–531.

Butler S, Fearon P, Atkinson L, Parker K. Testing an interactive model of symptom severity in conduct disordered youth. Criminal Justice and Behavior 2007;34:721–738.

Capaldi DN, Patterson GR. Can violent offenders be distinguished from frequent offenders: Prediction from childhood to adolescence. Journal of Research on Crime and Delinquency 1996;33:205–231.

Cleveland MJ, Feinberg ME, Bontempo DE, Greenberg MT. The role of risk and protective factors in substance use across adolescence. Journal of Adolescent Health 2008;43:157–164. [PubMed: 18639789]

Cleveland MJ, Gibbons FX, Gerrard M, Pomery EA, Brody G. 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 2005;76:900–916. [PubMed: 16026504]

Compton WM, Thomas YF, Conway KP, Colliver JD. Developments in the epidemiology of drug use and drug use disorders. American Journal of Psychiatry 2005;162:1494–1502. [PubMed: 16055770]

Crawford LA, Novak KB. Parental and peer influences on adolescent drinking: The relative impact of attachment and opportunity. Journal of Child and Adolescent Substance Abuse 2002;12:1–26.

Dierker LC, Avenevoli S, Goldberg A, Glantz M. Defining subgroups of adolescents at risk for experimental and regular smoking. Prevention Science 2004;5:169–183. [PubMed: 15470937]

Dishion, TJ.; Kavanagh, K. Intervening in adolescent problem behavior: A family-centered approach. Guilford Press; New York: 2003.

Dishion TJ, Kavanagh K, Schneiger A, Nelson S, Kaufman NK. Preventing early adolescent substance use: A family-centered strategy for the public middle school. Prevention Science 2002;3:191–201. [PubMed: 12387554]

Ennett ST, Flewelling RL, Lindrooth RC, Norton EC. School and neighborhood characteristics associated with school rates of alcohol, cigarettes, and marijuana use. Journal of Health and Social Behavior 1997;38:55–71. [PubMed: 9097508]

Ennett ST, Foshee YA, Bauman KE, Hussong A, Cai L, McNaughton Reyes HL, et al. The social ecology of adolescent alcohol misuse. Child Development 2008;79:1777–1791. [PubMed: 19037949]

Feinberg ME, Greenberg MT, Osgood WO, Sartorius J, Bontempo DE. Effects of the Communities That Care Model in Pennsylvania on youth risk and problem behaviors. Prevention Science 2007;8:261–270. [PubMed: 17713856]

Feinberg ME, Ridenour TA, Greenberg MT. Aggregating indices of risk and protection for adolescent behavior problems: the Communities That Care Youth Survey. Journal of Adolescent Health 2007;40:506–513. [PubMed: 17531756]

Fitzpatrick KM. Fighting among America's youth: A risk and protective factors approach. Journal of Health and Social Behavior 1997;38:131–148. [PubMed: 9212535]

Flay BR, Hu FB, Richardson J. Psychosocial predictors of different stages of cigarette smoking among high school students. Preventive Medicine 1998;27:A9–A18. [PubMed: 9808813]

Furman W, Buhrmester D. Age and sex differences in perceptions of networks of personal relationships. Child Development 1992;63:103–115. [PubMed: 1551320]

Galambos NL, Barker ET, Aleida DM. Parents do matter: Trajectories of change in externalizing and internalizing problems in early adolescence. Child Development 2003;74:578–594. [PubMed: 12705574]

Galea S, Nandi A, Vlahov D. The social epidemiology of substance use. Epidemiologic Reviews 2004;26:36–52. [PubMed: 15234946]

Gorman-Smith D, Tolan PH, Henry DB. A developmental-ecological model of the relation of family functioning to patterns of delinquency. Journal of Quantitative Criminology 2000;16:169–198.

Hammack PL, Richards MH, Luo Z, Edlynn ES, Roy K. Social support factors as moderators of community violence exposure among inner-city African American young adolescents. Journal of Clinical Child and Adolescent Psychology 2004;33:450–462. [PubMed: 15271603]

Henry KL, Slater MD. The contextual effect of school attachment on young adolescents' alcohol use. Journal of School Health 2007;77:67–74. [PubMed: 17222157]

Jackson C. Initial and experimental stages of tobacco and alcohol use during late childhood: relation to peer, parent, and personal risk factors. Addictive Behavior 1997;22:685–698.

Johnston, LD.; O'Malley, PM.; Bachman, JG.; Schulenberg, JE. Monitoring the Future national results on adolescent drug use: Overview of key findings, 2006. National Institute on Drug Abuse; Bethesda, MD: 2007. NIH Publication No. 07-6202

Johnston, LD.; O'Malley, PM.; Bachman, JG.; Schulenberg, JE. Monitoring the Future national results on adolescent drug use: Overview of key findings, 2007. National Institute on Drug Abuse; Bethesda, MD: 2008. NIH Publication No. 08-6418

Knoester C, Haynie DL. Community context, social integration into family, and youth violence. Journal of Marriage and Family 2005;67:767–780.

Kuendig H, Kuntsche E. Family bonding and adolescent alcohol use: Moderating effect of living with excessive drinking parents. Alcohol and Alcoholism 2006;41:464–471. [PubMed: 16624840]

Kumar R, O'Malley PM, Johnston LD, Schulenberg JE, Bachman JG. Effects of school-level norms on student substance use. Prevention Science 2002;3:105–124. [PubMed: 12088136]

Larson RW, Verma S. How children and adolescents spend time across the world: Work, play, and developmental opportunities. Psychological Bulletin 1999;125:703–736.

Leventhal T, Brooks-Gunn J. The neighborhoods they live in: The effects of neighborhood residence on child and adolescent outcomes. Psychological Bulletin 2000;126:309–337. [PubMed: 10748645]

Li C, Pentz MA, Chou CP. Parental substance use as a modifier of adolescent substance use risk. Addiction 2002;97:1537–1550. [PubMed: 12472638]

Li X, Stanton B, Feigelman S. Impact of perceived parental monitoring on adolescent risk behavior over four years. Journal of Adolescent Health 2000;27:49–56. [PubMed: 10867352]

Lin N, Ensel WM. Life stress and health: Stressors and resources. American Sociological Review 1989;54:382–399.

Lochman JE, van den Steenhoven A. Family-based approaches to substance abuse prevention. The Journal of Primary Prevention 2002;23:49–114.

Luthar S, Cicchetti D, Becker B. The construct of resilience: A critical evaluation and guidelines for future work. Child Development 2000;71:543–562. [PubMed: 10953923]

Masten AS, Faden VB, Zucker RA, Spear LP. Underage drinking: A developmental framework. Pediatrics 2008;121:S235–S251. [PubMed: 18381492]

Mounts NS. Parental management of adolescent peer relationships in context: The role of parenting style. Journal of Family Psychology 2002;16:58–69. [PubMed: 11915411]

O'Malley PM, Johnston LD, Bachman JG, Schulenberg JE, Kumar R. How substance use differs among American secondary schools. Prevention Science 2006;7:409–420. [PubMed: 16900406]

Plybon LE, Kliewer W. Neighborhood types and externalizing behavior in urban school-age children: Tests of direct, mediated, and moderated effects. Journal of Child and Family Studies 2001;10:419–437.

Rankin BH, Quane JM. Social contexts and urban adolescent outcomes: The interrelated effects of neighborhoods, families, and peers on African-American youth. Social Problems 2002;49:79–100.

Raudenbush, SW.; Bryk, AS. Hierarchical linear models: Applications and data analysis methods. Vol. 2nd Ed. Sage Publications; Thousand Oakes, CA: 2002.

Richards MH, Miller BV, O'Donnell PC, Wasserman MS, Colder C. Parental monitoring mediates the effects of age and sex on problem behaviors among African American urban young adolescents. Journal of Youth and Adolescence 2004;33:221–233.

Rountree PW, Clayton RR. A contextual model of adolescent alcohol use across the rural-urban continuum. Substance Use and Misuse 1999;34:495–519. [PubMed: 10210090]

Sampson RJ, Morenoff JD, Gannon-Rowley T. Assessing "neighborhood effects": Social processes and new directions in research. Annual Review of Sociology 2002;28:443–478.

Schabenberger, O. Introducing the GLIMMIX Procedure for Generalized Linear Mixed Models; Proceedings of the 30th Annual SAS Users Group International (SUGI) Conference; Cary, NC: SAS Institute Inc. 2005;

Scheier LM. Etiologic studies of adolescent drug use: A compendium of data resources and their implications for prevention. Journal of Primary Prevention 2001;22:125–168.

Schonberg MA, Shaw DS. Do the predictors of child conduct problems vary by high- and low-levels of socioeconomic and neighborhood risk? Clinical Child and Family Psychology 2007;10:101–136.

Simons RL, Simons LG, Burt CH, Brody GH, Cutrona C. Collective efficacy, authoritative parenting and delinquency: A longitudinal test of a model integrating community- and family-level processes. Criminology 2005;43:989–1029.

Simons-Morton B. Prospective analysis of peer and parent influences on smoking initiation among early adolescents. Prevention Science 2002;3:275–283. [PubMed: 12465590]

Spoth RL, Kavanaugh KA, Dishion TJ. Family-centered preventive intervention science: Toward benefits to larger populations of children, youth, and families. Prevention Science 2002;3:145–152. [PubMed: 12387551]

Spoth R, Redmond C, Shin C, Greenberg M, Feinberg M. Substance-use outcomes at 18 months past baseline: The PROSPER community-university partnership trial. American Journal of Preventive Medicine 2007;32:395–402. [PubMed: 17478265]

Stattin H, Kerr M. Parental monitoring: A reinterpretation. Child Development 2000;71:1072–1085. [PubMed: 11016567]

Steinberg L. We know some things: Parent-adolescent relationships in retrospect and prospect. Journal of Research on Adolescence 2001;11:1–19.

Substance Abuse and Mental Health Services Administration. Results from the 2006 National Survey on Drug Use and Health: National Findings. Rockville, MD: 2007. Office of Applied Studies, NSDUH Series H-32, DHHS Publication No. SMA 07-4293

Swaim RC. Individual and school level effects of perceived harm, perceived availability, and community size on marijuana use among 12th-grade students. Prevention Science 2003;4:89–98. [PubMed: 12751878]

Thomas YF. The social epidemiology of drug abuse. American Journal of Preventive Medicine 2008;32:S141–S146.

Tolan PH, Gorman-Smith D, Henry DB. The developmental ecology of urban males' youth violence. Developmental Psychology 2003;39:274–291. [PubMed: 12661886]

van den Bree MBM, Pickworth WB. Risk factors predicting changes in marijuana involvement in teenagers. Archives of General Psychiatry 2005;62:311–319. [PubMed: 15753244]

Van Horn ML, Hawkins JD, Arthur MW, Catalano RF. Assessing community effects on adolescent substance use and delinquency. Journal of Community Psychology 2007;35:925–946.

Wallace JM, Bachman JG, O'Malley PM, Schulenberg JE, Cooper SM, Johnston LD. Gender and ethnic differences in smoking, drinking and illicit drug use among American 8th, 10th, and 12th grade students, 1976-2000. Addiction 2003;98:225–234. [PubMed: 12534428]

Wickrama KAS, Bryant CM. Community context of social resources and adolescent mental health. Journal of Marriage and Family 2003;65:850–866.

Wickrama KAS, Noh S, Bryant CM. Racial differences in adolescent distress: Differential effects of the family and community for blacks and whites. Journal of Community Psychology 2005;33:261–282.

Wight RG, Botticello AL, Aneshensel CS. Socioeconomic context, social support, and adolescent mental health: A multilevel investigation. Journal of Youth and Adolescence 2006;35:115–126.

Windle M. Parental, sibling, and peer influences on adolescent substance use and alcohol problems. Applied Developmental Science 2000;4:98–110.

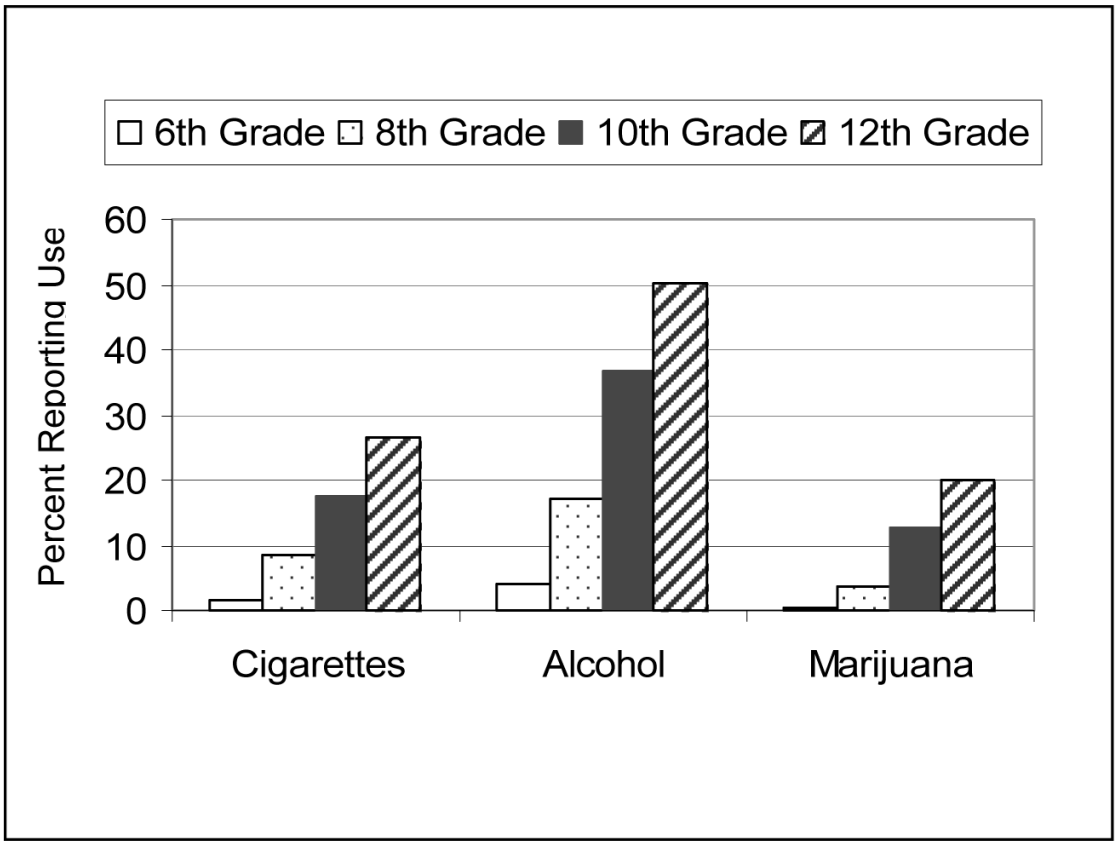

Figure 1.
Percent of students reporting recent cigarette, alcohol, and marijuana use by grade level.

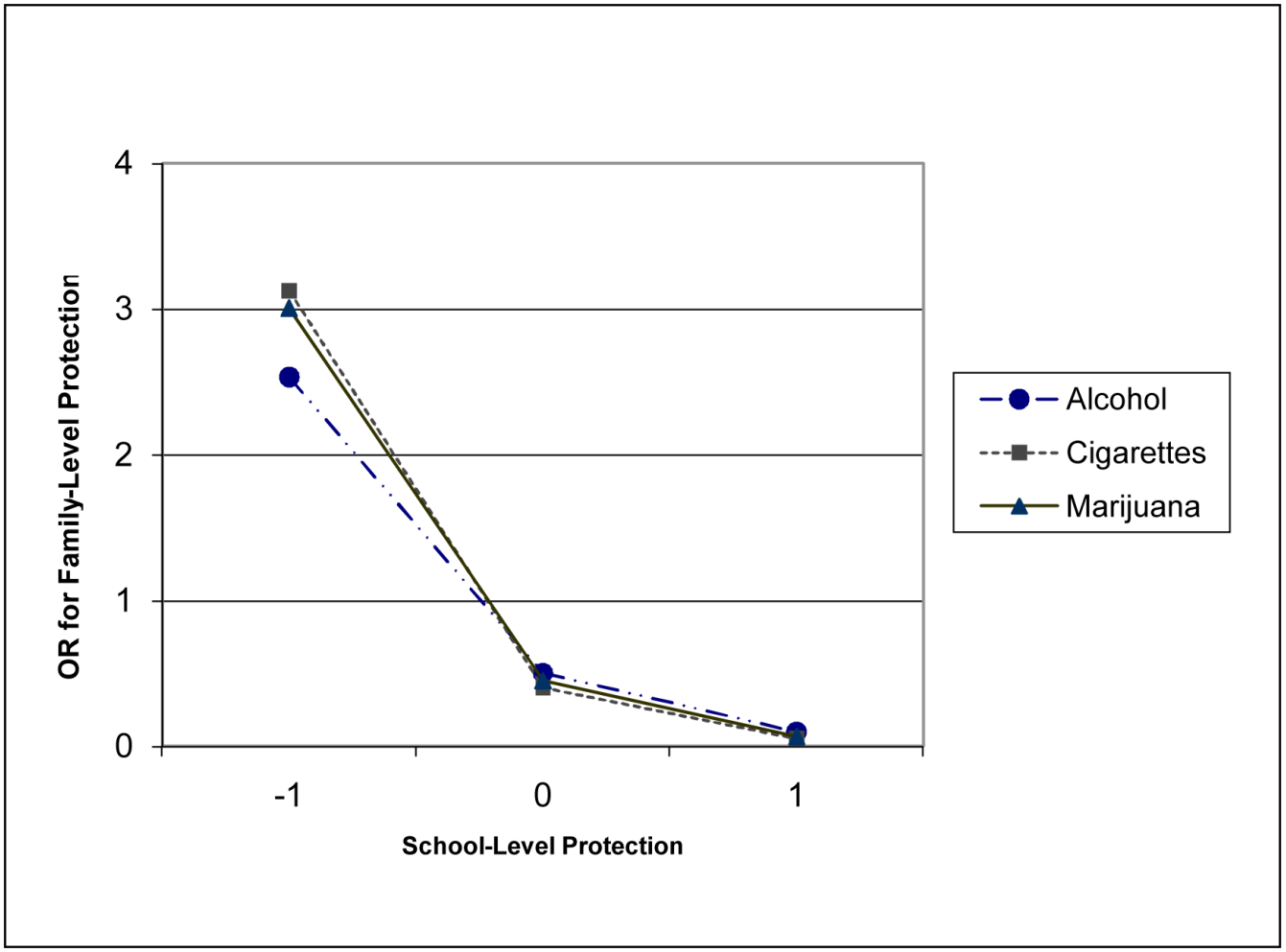

Figure 2.
Effects of family-level protective factors on ratio of odds of 10th grade recent cigarette, alcohol, and marijuana use across three levels of aggregated school-level family protection.

Table 1

Descriptive statistics for family-level and school-level predictor variables

	Individual Level								School Level	
	6th grade		8th grade		10th grade		12th grade			
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Family Protection	0.43	0.77	0.07	0.83	-0.22	0.83	-0.27	0.77	0.02	0.36
Separate Indices										
Attachment	0.32	0.73	0.00	0.80	-0.18	0.77	-0.14	0.76	0.00	0.26
Opportunity	0.33	0.78	0.00	0.87	-0.18	0.83	-0.17	0.82	0.00	0.26
Reward	0.32	0.72	0.02	0.79	-0.18	0.80	-0.17	0.78	0.01	0.28
Supervision	0.31	0.72	0.06	0.76	-0.20	0.83	-0.26	0.74	0.01	0.36
Discipline	0.42	0.77	0.14	0.80	-0.21	0.80	-0.38	0.75	0.03	0.36

Table 2

Pairwise correlations among study variables

	1	2	3	4
1. Family-Level Protection	---			
2. School-Level Protection	0.000	---		
3. Cigarette Use	-0.202*	-0.136*	---	
4. Alcohol Use	-0.200*	-0.197*	0.455*	---
5. Marijuana Use	-0.154*	-0.129*	0.498*	0.468*

* $p < .001$

Table 3

Results of Hierarchical Logistic Regression Models on 30-Day Substance Use by Grade Level

		6th grade		8th grade		10th grade		12th grade	
Dependent Variable	**Independent Variables**	**Coeff**	**OR**	**Coeff**	**OR**	**Coeff**	**OR**	**Coeff**	**OR**
Cigarette Use									
	Intercept	-4.38***	0.01	-2.76***	0.06	-1.78***	0.17	-1.24***	0.29
	Gender	-0.35*	0.70	-0.38***	0.68	-0.21***	0.81	-0.20***	0.82
	Free Lunch	0.40***	1.49	0.35***	1.42	0.37***	1.45	0.21***	1.23
	Family-level Prot	-1.05***	0.35	-0.70***	0.50	-0.91***	0.40	-0.45***	0.64
	School-level Prot	-0.24	0.79	-0.98**	0.38	-0.08	0.92	-0.01	0.99
	S X F Interaction	0.06	1.06	-0.11	0.90	-2.05***	0.13	-0.50	0.61
	FL X F Interaction	0.22**	1.25	0.12*	1.13	-0.01	0.99	0.05	1.05
Alcohol Use									
	Intercept	-3.44***	0.03	-1.67***	0.19	-0.50***	0.61	-0.13+	0.88
	Gender	0.14	1.15	-0.08	0.92	-0.06	0.94	0.02	1.02
	Free Lunch	0.11	1.12	0.07	1.07	0.04	1.04	0.03	1.03
	Family-level Prot	-0.41**	0.66	-0.45***	0.64	-0.69***	0.50	-0.38***	0.68
	School-level Prot	0.14	1.15	-0.91***	0.40	0.03	1.03	0.00	1.00
	S X F Interaction	-0.63	0.53	-0.27	0.76	-1.62***	0.20	-1.09***	0.34
	FL X F Interaction	0.07	1.07	0.05	1.05	0.00	1.00	-0.04	0.96
Marijuana Use									
	Intercept	-6.47***	0.01	-3.99***	0.02	-2.50***	0.08	-2.07***	0.13
	Gender	0.27	1.31	0.07	1.07	0.18**	1.20	0.24***	1.27
	Free Lunch	0.27	1.31	0.21*	1.23	-0.03	0.97	-0.10	0.90
	Family-level Prot	-0.07***	0.93	-0.73***	0.48	-0.80***	0.45	-0.49***	0.61
	School-level Prot	-0.21	0.81	-0.79*	0.45	-0.32	0.73	-0.41	0.66
	S X F Interaction	0.03	1.03	-0.11	0.90	-1.90***	0.15	-1.15***	0.32

		6th grade		8th grade		10th grade		12th grade	
Dependent Variable	**Independent Variables**	**Coeff**	**OR**	**Coeff**	**OR**	**Coeff**	**OR**	**Coeff**	**OR**
	FL X F Interaction	0.09	1.09	0.06	1.06	-0.09*	0.91	-0.01	0.99

all models estimated using SAS proc glimmix; distribution = binary.; G-side random effects only. Coeff = unstandardized beta coefficient; OR = odds ratio; Prot = Protection; S X F = school-level protection by family-level protection interaction, FL X F Interaction = Free lunch by family-level protection interaction.

* $p < .05$

** $p < .01$

*** $p < .001$

Table 4

Cross-level interaction coefficients in models estimating effects of specific family protective factors on recent substance use among 6th, 8th, 10th, and 12th grade students

	Cigarette Use				Alcohol Use				Marijuana Use			
	6th grade	**8th grade**	**10th grade**	**12th grade**	**6th grade**	**8th grade**	**10th grade**	**12th grade**	**6th grade**	**8th grade**	**10th grade**	**12th grade**
Attachment	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Opportunity	NS	NS	-0.63*	NS	NS	NS	NS	NS	NS	NS	NS	NS
Reward	NS	NS	-1.07***	NS	NS	NS	-0.84***	-0.55**	NS	NS	-0.92***	NS
Supervision	NS	-0.48*	-1.26***	-0.82***	-0.89***	-0.55***	-1.01***	-1.13***	NS	NS	-1.26***	-1.20***
Discipline	NS	NS	-1.92***	-0.97***	-1.23***	-0.81***	-2.14***	-1.22**	NS	-0.93*	-1.74***	-1.29***

all models estimated using SAS proc glimmix; distribution = binary; G-side random effects only; NS = non-significant *$p < .05$ *$p < .01$ *$p < .001$.