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## The importance of the community context in the epidemiology of early adolescent substance use and delinquency in a rural sample

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### Abstract

Considerable research has demonstrated that substance use and delinquency during early adolescence can have long-term negative health consequences. As the correlates of these behaviors cross levels and contexts, it is likely that a socioecological approach will provide insight to inform community prevention. This approach informs the present study, which focuses on developing a multiple-method measurement strategy to examine associations among community risks, resources, and rates of early adolescent substance use and delinquency in 28 rural and small town communities. Measures include five domains of community risk, four domains of community resources, and population rates of early adolescent substance use and delinquency. Results demonstrated that several measures of context were significantly associated with community rates of adolescent substance use and delinquency, and different risks and resources appear important for different outcomes. Multiple associations were curvilinear, and interactions may also be important. Findings suggest that it may be worthwhile to create and test new intervention strategies that target community factors in the pursuit of prevention.

### Keywords

Prevention; Community; Geographic Information Systems; Substance Abuse; Delinquency; Adolescence; Rural

### Introduction

Citizens, youth advocates and policy-makers have called attention to the role that *community* plays in promoting positive outcomes for youth (Clinton, 1996; Gore, 2003; McLaughlin, 2000; Whitford, 2005) and more funding has become available for community-level prevention efforts such as Drug Free Communities, State Incentive Grants (Department of Health and Human Services, n.d.), and Weed & Seed (Department of Justice, n.d.). It is expected that community-level policy and environmental interventions will lead to decreases in *population-level rates* of early adolescent substance use and delinquency, which place adolescents at risk for addiction and other negative outcomes (Caspi, Elder, & Bem, 1987; Chassin, Pitts, & Prost, 2002; Edwards, 1995; McGue & Iacono, 2005; Pitkanen, Lyyra, & Pulkkinen, 2005). However, there are few empirical studies on which policy and environmental interventions can be based, as there are few empirical studies that relate

independently measured community characteristics to population rates of adolescent substance use and delinquency.

### Conceptualization of Community

Understanding the community context within which an individual lives is crucial to understanding development (Bronfenbrenner & Morris, 1997), yet many different definitions of *community* are used. At times *community* is used interchangeably with *neighborhood* (Leventhal & Brooks-Gunn, 2000). The definition of community often has been left to the interpretation of research participants (Cook, Herman, Phillips, & Settersten, 2002; Ennett, Flewelling, Lindrooth & Norton, 1997), or at times defined by researchers as census blocks or tracks (Cook et al., 2002; Duncan, Duncan, & Strycker, 2002; Peterson, Krivo, & Harris, 2000), school districts (Dent & Biglan, 2004), a specific school catchment area (Ennett et al., 1997), or zip codes (Gruenewald, Johnson, & Treno, 2002). At other times researchers have incorporated landmarks and/or social and economic indicators to define a community or neighborhood (Chuang, Cubbin, Ahn, & Winkleby, 2005; Sampson, Raudenbush, & Earls, 1997).

Much of the prior research that investigates community effects on adolescent substance use and other problem behaviors has been conducted at the individual-level: examining how individual perceptions of the community context have influenced individual outcomes (Arthur, Hawkins, Pollard, Catalano & Baglioni, 2002; Leffert et al., 1998; Resnick, Ireland, & Borowsky, 2004). This analysis strategy can be subject to a method- and reporter-bias (Campbell & Fiske, 1959; Dodge, 2008).

Recently research has related community-level factors to individual and/or community-level outcomes, but this work has focused mostly on urban settings and/or on the broad construct of disadvantage (Brody et al., 2001; Brown, Ang, & Pebley, 2007; Beyers, Bates, Pettit & Dodge, 2003; Lynam et al., 2000). The present study expands on prior work by: (a) employing a broad multi-method assessment of the community context that is informed by an interdisciplinary approach (Leventhal & Brooks-Gunn, 2003; O'Campo, 2003); (b) focusing on rural communities and small towns which generally show high rates of early experimentation with gateway drugs such as alcohol and tobacco (Brown, Schulenberg, Bachman, O'Malley, & Johnston, 2001; Edwards, 1995; Eitle & Eitle, 2004); (c) using adolescent reported outcomes to assess the population-rates of these behaviors (Mrazek, Biglan, & Hawkins, 2003); (d) examining geographically distinct communities, rather than one large geographic area divided into several smaller adjacent areas, which removes spatial autocorrelation (Wieczorek & Hanson, 1997); and (e) conducting analyses at the community-level, with community-level predictors and aggregates of a population-level survey as outcomes. We utilize data aggregated to the community-level, rather than multi-level analyses with the dependent variable at the individual-level because the current study is concerned with predicting the *prevalence* of early adolescent substance use and delinquency in communities, rather than the behavior of individuals.

### The Current Study

The current study draws from a multi-disciplinary ecological model (Bronfenbrenner & Morris, 1997) to understand the complex nature of human and community development. The current study also draws from a risk and protective factor framework to hypothesize associations with community rates of adolescent substance use and delinquency (Hawkins, Catalano, & Miller, 1992; Rutter, 1990). Five risk domains and four resource domains were selected because of their salience in individual etiological research or because of their salience in predicting community outcomes such as crime. The five risk domains include economic risk, residential instability, crime, the substance use environment, and school

district risk (Ennett et al. 1997; Hawkins, Van Horn & Arthur, 2004; Plybon & Kliwer, 2001; Resnick et al., 2004; Sampson et al., 1997; Treno, Grube, & Martin, 2003), and the four community resources selected include school district leadership, collective efficacy, the availability of structured activities for middle school students, and the presence of youth-serving organizations (Elliott et al., 1996; Hawkins et al., 2004; Haynes & Comer, 1996; Osgood, Anderson, & Shaffer, 2005; Peterson et al., 2000).

The current study investigates four hypotheses. First, we hypothesize that the five risk domains will have strong positive associations with each other. Second, we hypothesize that all risks will be positively related to community rates of adolescent problem behaviors, whereas three out of the four resource domains (school leadership, collective efficacy, and the presence of youth-serving organizations) will be negatively related to community rates of adolescent problem behaviors. Following previous research (Osgood & Chambers, 2000), this test includes a squared term in all risk/resource-outcome models because some main effect associations will be curvilinear. Third, we hypothesize that the community-level availability of structured activities will be moderated by the communities' transportation resources, such that the protective effect of structured activities will be stronger in communities that provide bus transportation home for youth after school activities. Lastly, we examine whether a measure of accumulated resources will moderate the association between a measure of accumulated risks and community rates of adolescent problem behaviors, such that community rates of adolescent problem behaviors will be lower in communities that have many community-level risks when the community has high levels on multiple resources.

## Method

The sample included all 28 sites of the PROSPER (PROmoting School-university-community Partnerships to Enhance Resilience) project in Pennsylvania and Iowa. PROSPER is a community-level randomized trial of a new dissemination system for empirically validated prevention programs, where the Cooperative Extension System [CES] and public school system play central roles (Spoth, Greenberg, Bierman, & Redmond, 2004). The system has connected local CES educators with the local public school system to build a community team that assesses the health and well-being of their youth and families. This team is connected to education and prevention resources at the university and state-level by extension prevention coordinators (PCs). The community team selects, receives training, and oversees the implementation of empirically validated prevention programs with support from the PCs and university resources.

Primary eligibility criteria for communities were (a) total school district enrollment (k-12) between 1301–5200 students located in non-metropolitan areas; (b) districts with at least 15% of families eligible for free or reduced lunches; (c) districts with less than half of the population employed by or attending a university; and (d) districts not involved in other university-affiliated youth-prevention research projects. Both universities' Institutional Review Boards (IRBs) approved the study before participant recruitment began.

## Participants & Procedures

Data for this project was collected from a total of eight different sources: 1) interviews with key community leaders, 2) interviews with directors of human service agencies, 3) interviews with middle school principals, 4) interviews with youth activity experts, 5) surveys collected from 8<sup>th</sup> grade students, 6) census data, 7) other archival data sources, and 8) data derived from GIS technologies. Individuals involved in data collection were recruited in a variety of ways and at different time points to limit respondent burnout and

improve data validity (see below). Table 1 contains a listing of the measures, the targeted sample for each measure, and the time point at which each construct was collected.

**Community leaders**—The community leader sample included 226 individuals that were recruited with the start of the project in the spring of 2002. In the intervention communities, individuals consisted of local stakeholders on the PROSPER project teams. These individuals included local cooperative extension and school representatives, local mental health and substance abuse agency representatives, and parents. In the control communities, similar representatives from Extension, the school, and community were recruited. Respondents ranged in age from 22–62 ( $M = 43.0$ ,  $SD = 8.89$ ), 31% of respondents were male, and 99% were white. Most respondents obtained a minimum of a college degree (92%) and most (80.2%) lived in or near the school district involved with the PROSPER project.

**Agency directors**—The agency director sample included 92 individuals recruited at the start of the project in the spring of 2002. These individuals served as directors of human service agencies or the school district (e.g. supervisor of mental health, substance abuse, cooperative extension, etc.). Respondents ranged in age from 25–65 ( $M = 47.4$ ,  $SD = 9.5$ ), 73.1% of the sample was male, and 100% were white. Most have obtained at least a college degree (97%).

**Middle school principals**—Thirty-three middle school principals provided information on their respective schools. Their average tenure as building principal averaged 5.4 years (range 0 – 19.0,  $SD = 6.5$ ).

The community leader, agency director, and school principal samples were recruited by local extension educators and school district representatives. These individuals participated in one-hour computer-assisted face-to-face interviews in 2002 and every year thereafter. The community leader and agency director samples were compensated with \$20.

**Youth activity experts**—The youth activity expert sample was divided into two groups. The first group included 98 individuals who provided a total of 106 interviews lasting approximately 45 minutes; eight individuals were knowledgeable about two different communities. Respondents were community members that were directly involved in planning and/or leading a variety of activity programs for middle school students (e.g. Extension 4-H youth development educators, PE teachers, local parks and recreation and/or a YMCA employees, youth ministers, etc.). Thirty-nine percent of the sample was male.

The second group included 133 directors of specific youth activity programs. This sample was recruited for 10-minute phone calls by phone upon the recommendations of the first group above regarding who directs the most important activities in the community.

**Student sample**—The youth sample included a total of 5261 eighth graders, for an average of 188 students per community (range 84–395). Respondents ranged in age from 12.5–16.3 ( $M = 14.3$ ,  $SD = 0.43$ ), 50% were male, and 85.3% were Caucasian. The remaining sample consisted of a mix of racial/ethnic minorities (6.0% Hispanic/Latino, 3.2% African American, 1.3% Native American, 1.4% Asian, and 2.8% Other).

The students were recruited from all eighth grade classes during the 2004–2005 school-year; the 2004–2005 school-year was the third year of the survey. A passive parental consent process which allowed parents to decline participation for their student that was approved by both IRBs was implemented prior to the 45-minute in-school survey. In an effort to obtain a population-level measure of adolescent substance use and delinquency, the research team

held make-up sessions in every district. These efforts resulted in a nearly 90% participation rate of district enrolled eighth-grade students.

**Geographic information systems (GIS) methods**—As described below, there were several measures that used GIS. GIS software matched specific street address locations to particular latitude and longitude by using a comprehensive street-file database (i.e. to *geocode* an address). All address locations were geocoded by a GIS specialist using ArcGIS 9.1 (Environmental Systems Research Institute, 2005); 20% of the geocoded address locations were checked for quality control with online mapping services. In all, 95% of the student addresses, 87% of the youth activity locations, 95% of the alcohol retail locations and 88% of the tobacco retail locations were successfully geocoded.

## Measures

The measures of community risks, resources, and rates of problem behaviors are described below<sup>1</sup>. Descriptive statistics of measures are located in Table 1.

**Economic risk**—Two measures were standardized ( $M = 0$ ,  $SD = 1.0$ ) and averaged to assess community economic risk: community poverty is the percent of families within the district boundaries that live below the poverty threshold (National Center for Education Statistics [NCES], 2003), and district low income is the percent of students receiving free or reduced cost lunches as reported by school district offices.

**Residential instability**—Residential instability is the percentage of residents (in the year 2000) over the age of five that have moved their residence in the last five years (NCES, 2003).

**Crime rates**—Three indices of crime were standardized ( $M = 0$ ,  $SD = 1.0$ ) and averaged to create an overall crime measure for each district: the rate of violent crimes, property crimes, and narcotic crimes. Figure 1 models the three step process that was used to create school district crime rates from both states' crime reporting system (Coco, 2005; Pennsylvania State Police, 2005). First, the number of crime incidents in each crime jurisdiction within school district boundaries was weighted by the percent of that crime jurisdiction that is geographically located within school district boundaries. Second, the weighted crime incidents for each crime jurisdiction were summed within each school district. Third, the summed number of incidents was divided by the total district population and multiplied by 100,000, to create a rate of crime incidents per 100,000 residents. Multiple years of data (2002–2004) were averaged to correct for possible reporting biases<sup>2</sup> (Lee & Ousey, 2001; Osgood & Chambers, 2000).

**Substance use environment**—Multiple measures that describe the community norms and availability of substances were standardized ( $M = 0$ ,  $SD = 1.0$ ) and averaged to create an overall substance use environment scale for each community. First, perceived norms (4-items,  $\alpha = .80$ ; Beebe, Harrison, Sharma, & Hedger, 2001) assesses community leader perceptions of acceptance of adolescent alcohol and tobacco use; an example item is, “Adults in [this community] think the use of alcohol is a normal part of growing up.” Second, perceived availability (2-items,  $r = .51$ ; Beebe et al., 2001) measures community

<sup>1</sup>Interview protocols and more specific information about measure creation are available from the first author.

<sup>2</sup>Crime reporting is a voluntary in both Pennsylvania and Iowa. Crime rates were unable to be computed for one PA school district because the four municipalities that the school district serves have not reported any crime data to the State, and efforts to get this information from the municipal offices directly were not successful. Hence, the  $n$  for all analyses which include this district is 27 instead of 28.

leader perceptions of the availability of alcohol and tobacco to adolescents; an example item is, “How easy is it for middle school students in your community to obtain [alcohol/tobacco]?” Third, the density of alcohol and of tobacco retailers (per 10 km) assesses community availability of alcohol and tobacco (Gruenewald et al., 2002). Density scores were created separately for alcohol and tobacco by geocoding the address locations, summing the number of alcohol and tobacco outlets within each district, dividing the total number of alcohol and tobacco outlets by the total number of kilometers of roadway within each district, and then multiplying by 10.

**School district risk**—Two measures were standardized ( $M = 0$ ,  $SD = 1.0$ ) and averaged to create an overall measure of school district risk. First, district academic risk is based on the percentage of 8<sup>th</sup> grade students that were not “proficient” on the math and reading standardized tests in 2002. Because the states use different tests, a three-step process was used to create the variable. Each district was rank-ordered within each state from the highest scoring to the lowest scoring district separately for the math and reading tests (i.e. higher scores indicated worse achievement). Then, an overall district academic achievement variable was created by taking the mean of the math rank and reading rank scores. The second scale, school problems (2-items;  $r = .33$ ; Chilenski, Greenberg, & Feinberg, 2007), assesses community leader and agency director perceptions of the degree to which the district is perceived to be plagued with problems; an example item is: “The school district struggles to provide sufficient resources to carry out its mission—for example, it is understaffed, space is tight, and/or books and supplies are needed.”

**Collective efficacy**—Two sub-scales of community readiness (Chilenski et al., 2007) were averaged to assess collective efficacy. First, community attachment (3-items,  $\alpha = .56$ ) measures community leader and agency director perceptions of the level of resident investment and closeness in a community; an example item is: “Most people who live here feel a strong tie to this community.” Second, community initiative (4-items,  $\alpha = .65$ ) measures community leader and agency director perceptions of the level of active engagement of community members; an example item is: “Most people in this community are committed to addressing community issues.” These scales are conceptually congruent to those used by Sampson and colleagues (1997), but were slightly modified because of the larger project’s intent.

**School leadership**—One scale was used to assess the degree to which the school district leadership is perceived by community leaders and agency directors to be effective and proactive (4-items,  $\alpha = .80$ ; Chilenski et al., 2007); an example item is: “The middle school does a good job of reaching out to parents.”

**Youth activity opportunities**—Three scales were combined to assess community availability of structured youth activities<sup>3</sup>. First, the perceived availability (3-items,  $\alpha = .75$ ) of structured youth activities for middle school students is assessed by all interview respondent samples; an example item is: “This community provides quality recreational opportunities for middle school students.” Second, a student rate of structured activities assesses the number of activities available per 1,000 middle school students. This scale was

<sup>3</sup>These three variables were combined in a three step process. First, the sample was rank-ordered on each of the three structured activity variables (perceived availability, student rate of opportunity, and time spent in activities). Second, the top and bottom quarter of the sample was given a score of “1” and “-1”, with the middle 14 communities given zeros on each variable, respectively. Third, any community that was ranked in the top of the distribution on two out of the three variables received a “1” whereas a community that was ranked in the bottom of the distribution on two out of the three variables receives a “-1”. The remaining communities received a “0” on the domain score. Use of this strategy to create a structured activities domain score is supported by correlation matrices that demonstrated the domain score to be equally representative of the three sub-scales ( $r = .54$  w/ perceived availability;  $r = .69$  w/ student rate of activities;  $r = .65$  w/ time spent).

created by counting each unique organization and activity type reported in interviews, then dividing by the middle school population and multiplying by 1,000. The categories of activities were developed based on the individual-participation literature (Coatsworth et al., 2005; Eccles & Barber, 1999).

The third scale, time spent in structured activities, assesses the average number of hours a typical middle school student in each district participates in structured activities over the course of the school-year. This scale was derived in a three-step process from information obtained from the follow-up sample of Activity Experts. First, the number of participants, the number of weeks, and the average number of participation hours each student spent in the activity each week were multiplied together for the three activities that were reported as most influential. Second, the total number of participation hours was summed across these three activities. Third, the total number of participation hours in the most influential activities was divided by the middle school student population.

**Youth-serving organizations**—The density of youth-serving organizations was derived through searches of online phone books (superpages.com, 2005) and the YMCA webpage (2005). Two searches were conducted to generate a comprehensive list of youth-serving organizations. The first search included inputting the name of the main town and state of the school district into the appropriate search fields, with a 30 mile radius as the catchment area. The second search was modified to use the zip codes of the students that attended each district and a slightly smaller, 20-mile radius. In both searches, the category listings used for the online phone books were “youth organizations, centers, and clubs,” “youth service organizations,” “all sports and recreation clubs and organizations,” “martial arts instruction,” and “dance studios.” Any organization that was focused on adults was not included in the database. In every case, the zip-code search yielded few additional listings. Additionally, the street addresses of the activity organizations were put into the American Fact Finder Web Page (US Census, 2005) in order to ensure that a larger geographic area than the specific school districts in question was being captured through the above search methods. Both of these procedures confirmed that a comprehensive listing of possible organizations was generated.

**Transportation**—One question, “Does this school provide busses to get students home from after school activities?” was asked to assess transportation resources to middle school principals. Response options were coded yes = 1, and no = 0.

**Adolescent problem behaviors**—Community-rates of adolescent lifetime alcohol use, lifetime cigarette use, past 12-month aggressive behavior, and past 12-month property destruction are the dependent variables as assessed by the self-report of eighth grade students (Elliott, Huizinga, & Menard, 1989). Individual responses for all items were coded to be dichotomous (0=No /1=Yes) and then averaged within each community to create community rates of adolescent problem behaviors. *Alcohol use* assessed if the student has ever drunk more than just a few sips of alcohol (ICC = .01). *Cigarette use* assessed if the student has ever smoked a cigarette (ICC = .03). *Aggressive behavior* assessed if the student has purposefully beat up someone or physically fought with someone because they made you angry, or thrown objects such as rocks or bottles at people to hurt or scare them within the last 12 months (ICC = .01). *Property destruction* assessed if the student had purposely damaged or destroyed property that did not belong to them within the last 12 months (ICC = .01). As in previous research (Hawkins et al., 2004), estimates of the Intraclass Correlations for the dependent variables in this sample of relatively homogeneous communities were quite small, yet significant. Thus, the greater majority of the variance occurred at the individual-level.

## Results

### Preliminary Analyses

Descriptive statistics of all measures are listed in Table 1. Average rates of community risks were generally below national averages of similar measures (US Census, 2000; FBI, 2004), however, average rates of adolescent problem behaviors were higher than nationally representative samples (Johnston, Terry-McElrath, O'Malley, & Wakefield, 2006; Centers for Disease Control and Prevention [CDC], 2006). Community resources cannot be compared due to the absence of standardized measures.

Pearson correlations among community risks, resources, and dependent variables are presented in Table 2. Three main findings emerged. First, several community risks had positive associations. For example, high levels of economic risk were associated with higher levels of crime, a more pro-substance use environment, and worse district functioning. Two exceptions were found: a negative association between residential instability and the substance use environment, and no association between residential instability and economic risk. Second, with one exception (i.e., positive correlation between school leadership and density of youth-serving organizations), community resources were not positively associated. Third, some community risks were positively associated to community resources where others were negatively associated. For example, the substance use environment and economic risk associated positively to the density of youth-serving organizations, whereas collective efficacy associated negatively to academic risk and school problems.

### Considerations in Hypothesis Testing

Analyses needed to control for experimental condition because the youth-reported outcomes were taken from the third year of the study. Analyses also controlled for state due to the focus on context. Given the N of 28 communities and that effect sizes in community-level research are typically moderate,  $r = .30$  through  $r = .45$  (Duncan et al., 2002; Osgood & Chambers, 2000; Sampson et al., 1997), power analyses were conducted to assess the appropriate significance level to balance protecting against both Type I and Type II errors. As in similar research (Pentz & Riggs, 2008), the multiple regression analyses used a 1-tailed, direction specific with  $p < .10$  as the minimal statistical significance criterion. Using this significance criterion, the current study had statistical power of .70 to explain about 10% of the variance ( $r = .35$ ) in the dependent variable (UCLA, 2004). Scatterplots and fit statistics were also inspected to guard against generalizing results to the entire sample when they were driven by outliers.

### Regression Analyses

Domain-specific regressions were conducted for each of the four dependent variables (i.e. rates of youth problem behavior). The main effect (a linear term and a squared term) of each risk and resource was tested in a separate model which included state and experimental condition as controls. Gender was added as an additional control for the aggressive behavior and property destruction models.

**Community risks**—The second hypothesis tested whether higher levels of community risks associated with higher rates of adolescent substance use and delinquency. This hypothesis received some support. Specific results are presented below.

First, none of the community risks were significantly associated with community rates of adolescent alcohol use. Second, community rates of adolescent cigarette use had significant positive linear associations with economic risk ( $B = .04$ ,  $p < .01$ ,  $R^2 = .33$ ) and school district risk ( $B = .06$ ,  $p < .01$ ,  $R^2 = .41$ ). Third, community rates of adolescent aggressive



behavior had a significant positive linear association with residential instability ( $B = .003$ ,  $p < .10$ ,  $R^2 = .28$ ) and a significant positive curvilinear association with school district risk ( $B = .02$ ,  $p < .05$ ,  $R^2 = .30$ ) such that the rate of aggressive behaviors (i.e. the slope of the regression line) increased more markedly at the higher end of the school district risk distribution. Fourth, community rates of adolescent property destruction had significant positive linear associations with crime ( $B = .02$ ,  $p < .10$ ,  $R^2 = .18$ ) and residential instability ( $B = .004$ ,  $p < .05$ ,  $R^2 = .28$ ).

**Community resources**—The second hypothesis also tested whether higher levels of community resources associated with lower levels of rates of adolescent substance use and delinquency. This hypothesis received some support. Specific results are presented below.

First, community rates of adolescent alcohol use had a negative linear association with school leadership ( $B = -0.12$ ,  $p < .01$ ,  $R^2 = .22$ ) indicating that schools rated as proactive were associated with lower rates of alcohol use. Further, a significant curvilinear association was found with the density of youth-serving organizations ( $B = 1.18$ ,  $p < .05$ ,  $R^2 = .08$ ) such that the rate of alcohol use (i.e. the slope of the regression line) decreased more markedly at the low end of the youth-serving organizations variable and then flattened as the level of youth-serving organizations increased. Second, community rates of adolescent cigarette use had negative linear associations with collective efficacy ( $B = -0.11$ ,  $p < .10$ ,  $R^2 = .17$ ) and school leadership ( $B = -0.08$ ,  $p < .10$ ,  $R^2 = .18$ ). Third, community rates of adolescent aggressive behavior had a linear trend with collective efficacy ( $B = -0.05$ ,  $p = .11$ ,  $R^2 = .25$ ) and a significant curvilinear association with school leadership ( $B = -0.25$ ,  $p < .05$ ,  $R^2 = .44$ ), such that the rate of aggressive behaviors (i.e. the slope of the regression line) decreased more markedly at the higher end of the school leadership distribution. Fourth, community rates of adolescent property destruction had a significant curvilinear association with school leadership ( $B = -0.29$ ,  $p < .05$ ,  $R^2 = .36$ ) such that the rate of property destruction (i.e. the slope of the regression line) decreased more markedly at the higher end of the school leadership distribution.

The third hypothesis tested whether community availability of structured activities interacted with transportation resources in associating with community rates of adolescent substance use and delinquency. This hypothesis was not confirmed as community availability of structured activities interacted with transportation only at the level of a trend when associating with rates of adolescent aggressive behavior ( $B = -0.04$ ,  $p = .13$ ,  $R^2 = .21$ ).

**Accumulated risks and accumulated resources**—The fifth hypothesis tested whether communities with high levels on multiple risks had lower levels of problem behaviors when they also had high levels on multiple resources. Before testing this hypothesis, aggregated risk and aggregated resource variables needed to be constructed.

Cut-points at one standard deviation above the mean were used to define whether a community *had the risk* (=1, vs. no risk=0) or *had the resource* (=1, vs. no resource = 0). This cut-point was selected for both statistical and theoretical reasons. First, scatterplots and stem and leaf plots of all risks and resources were initially examined for natural cut-points within the distributions. Often, natural cut-points were very close to the standard deviation. Second, as this community sample is relatively low risk compared to national statistics, splitting the sample at one standard deviation above the mean ensured that communities with more extreme levels are highlighted as having risk or resources. Third, using the standard deviation resulted in more substantial cell sizes (compared to other cut-point methods), which was likely to generate more reliable estimates of the main effects and the interaction.

This hypothesis received limited support. Accumulated risks interacted with accumulated resources only in associating with community rates of adolescent property destruction ( $B = -0.02$ ,  $p < .05$ ,  $R^2 = .28$ ) such that communities with high levels on multiple risks and high levels on multiple resources had the lowest rates of adolescent property destruction (see Figure 2).

## Discussion

The present study took an ecological approach to examine the occurrence of early adolescent substance use and delinquency in a rural context. The communities in the sample can be described as rural, small towns and large towns that are centered on farming or industry. Compared to national statistics, these communities have relatively low rates of poverty, crime, single-family households, mobility, and a smaller presence of minorities. However, their rates of early adolescent substance use and delinquency are comparable or higher than national averages. These characteristics make this community sample uniquely appropriate to expand on prior socioecological research that focuses on urban areas (Brown et al., 2007; Beyers et al., 2003). The current study also expanded prior research by using a multiple-method measurement strategy with independence between measures of youth behaviors and context.

The current study has four main findings. First, preliminary analyses show that community risks tend to occur together, whereas community resources are less related to each other. In addition, communities with more risks do not necessarily have a low number of youth-related resources. These findings indicate that community risks and resources may act independently in predicting youth outcomes. Second, some community risks and resources were related to community rates of early adolescent problem behaviors, but these findings were not as consistent as hypothesized based on previous research (Brody et al., 2001; Beyers et al., 2003; Hawkins et al., 2004; Lynam et al., 2000; Resnick et al., 2004). Third, assessment of the quality of the school district context was most consistently associated with rates of early adolescent problem behaviors. Fourth, interactions among community risk and resource levels may deserve consideration. These findings point to the importance of including a wide range of communities, using multiple methods and raters, and taking a holistic approach to understand context effects.

### The Importance of a Studying Context in a Wide Range of Communities

Initial analyses demonstrated that community risks tended to occur together, in that economic risk acted as a focal point. In this sample, economic risk associated positively with the substance use environment, school district risk, and crime. However, residential instability did not associate with economic risk, and residential instability had a negative association with the substance use environment.

The findings here support previous findings that poverty may have a different impact in rural areas. For example, previously poverty showed little association with mobility (Lee & Ousey, 2001) and juvenile arrest rates (Osgood & Chambers, 2000) in rural areas. While rural areas have become increasingly dependent on adjoining urban areas for services, urban areas have become less dependent on the products of rural areas (Hughes, 2000). Together, the lower cost of rural living, fewer social services, and a less developed infrastructure may make rural poverty more stable than it is in cities. Thus, while community-level poverty was negatively related to mobility, it was positively associated with the substance use environment.

The current study also found that community risks and resources were not consistently related to early adolescent risk behaviors. For example, economic risk was associated with

rates of cigarette smoking; crime was associated with rates of property destruction; school district risk was associated with cigarette use and aggressive behavior. The substance use environment was not associated with any outcome measures. Collective efficacy was only associated with cigarette use and had a trend with aggressive behavior, and the presence of youth organizations was associated solely with rates of alcohol use. In contrast, the quality of school district leadership was consistently associated with all four outcomes. These findings could indicate that different elements of context are more important when considering different outcomes. For example, adolescent alcohol use may be so common in rural areas that few community characteristics may predict it. Collective efficacy may be more important for cigarette use and aggressive behavior, as the broad anti-smoking and anti-violence campaigns may be realized in communities with higher levels of collective efficacy. Mobility may be more important for property destruction, as an instable population may place less value on physical surroundings.

Taken together, our findings and findings from prior research that have included at least two geographically distinct communities or non-urban populations (Cancino, 2005; Elliott et al., 1996; Ennett et al., 1997; Osgood & Chambers, 2000) point to the importance of including a broad range of communities in context research. Each study has used slightly different measures of community, predictors, and outcomes, has drawn from different samples, and has slightly different results. For example, it is possible that structural disadvantage is associated with more severe outcomes such as crime rather than health risk behaviors that are seen as “regular” or “normal” such as early adolescent substance use (Ennett et al., 1997). At present, it remains unclear whether it is the different types of communities, samples, or measures that have led to different outcomes. More studies of community-level characteristics in a variety of geographically independent communities are required to better understand these processes.

### Issues in Defining and Measuring Context

The field of socioecological research will also be strengthened by improving how context is measured. In the current study, we utilized a theoretically meaningful definition of community, included a broad range of independently assessed measures of context, and explored how combinations of community-level risks and resources might interact to explain youth outcomes.

**Defining community**—As summarized earlier, there are many different ways community and/or neighborhood has been defined and operationalized. Here, *community* was equivalent to school district boundaries. This level was selected because these are meaningful geographic divisions for adolescents (Ennett et al., 1997; Resnick et al., 2004); much of community life for teens in small towns is related to activities in the school district. A definition of the local school or neighborhood may be more appropriate in urban or suburban samples that have more than one high school and more diversity. Further, it is possible that different elements of context operate at different levels. For example, we created a district-level measure of crime which had construct validity; however, it only associated with rates of property destruction. Crime may operate at a smaller level of community, such as street block, neighborhood, or in rural areas, municipality.

**Using independent measures of context**—It is also important for socioecological research to continue using a range of methods and informants to assess the community environment (Leventhal & Brooks-Gunn, 2003; O’Campo, 2003); and this approach should include independent ratings of predictors and outcomes whenever possible. Using more objective and independently assessed measures can better inform community prevention and community health activities. For example, GIS measures of social services more accurately

suggest community-level policies regarding the number and/or availability of social services whereas a measure of parent-reported social services in a neighborhood (Cook et al., 2002) more accurately suggests individual-level interventions aimed at improving knowledge of social services.

**Take a holistic approach**—The current findings also suggest the importance of taking a holistic approach to understand context effects. Our findings demonstrated that some community factors had stronger and more consistent associations with some outcomes compared to others, and we found one significant interaction. It is likely that the process by which the community context exerts its influence on community and individual outcomes is complex. Some elements of context may be directly associated with individual and/or community outcomes, while the influence of others may be indirect, and other outcomes may only surface when multiple conditions are met. For example, though individuals choose where they live, that choice is limited by the cost and availability of housing, income, the acceptance of housing vouchers, and possibly even how various individuals are welcomed into different neighborhoods.

The significant interaction between accumulated risks and accumulated resources may suggest that the concept of resilience can be generalized to the community-level; in other words, it may be possible for communities with high levels of adversity *and* high levels of resources to have better than expected outcomes, and recently the concept has been applied to preventing health disparities (Davis, Cook & Cohen, 2005). The current findings reinforce that the community should be understood as a system of complex interconnected associations, and future socioecological research should take a holistic approach to understand context.

### The Importance of the School Context

Out of all the constructs studied, the school context most consistently associated with rates of early adolescent problem behaviors. Population rates of adolescent self-reported alcohol use, cigarette use, aggressive and delinquent behavior were lower in high-functioning districts, as measured by community leader perceptions that the district leadership places an importance on school-family relationships, deliberately reaches out to involve families, is well respected, and is able to follow-through when it sets goals. Similarly, population rates of cigarette use and aggressive behavior were higher in districts with poor achievement, where community leaders sensed that the district was overwhelmed with problems, and was generally disorganized.

These findings begin to generalize that the middle school context is important to social and behavioral outcomes in addition to academic outcomes (Eccles et al., 1993), and it suggests that there may be true school- and district-level practices that associate with community rates of adolescent substance use and delinquency. The current findings suggest that it may be important for districts to integrate family outreach into its mission and practices and to be careful to set realistic goals. These findings also suggest that school functioning, though highly related to community economic levels, is not solely determined by economics. Future research that investigates these mediators (parental involvement, specific outreach strategies, etc.) is needed. It is possible that districts with strong leadership have better communication with parents and families and that they are more welcoming and inclusive of parents and families. District and/or school leaders that prioritize outreach and engagement with parents may create a connection between school and family that reinforces positive messages (National Research Council, 2002).

## Implications for Community Action and Intervention

This study has a number of implications for the field of community-based research, action, and intervention. First, these findings highlight how community-level measurement and community-level research questions can be used to understand and inform the development of new community-level interventions that aim to reduce rates of adolescent substance use and delinquency. The findings suggest that it may be worthwhile to create and test new intervention strategies that target factors such as school district leadership practices, collective efficacy, residential instability, and economic risk. The current study did not test causation; this is an early and necessary step in community-level epidemiological research. It is possible that interventions that change the levels of these risks and resources will improve youth outcomes.

There are numerous ways community risks and resources may be changed. For example, the mission and actions of school districts may be altered through training and professional development opportunities. Economic risk and residential instability may be decreased through logistical efforts such as increasing job opportunities and/or the minimum wage, and improving access to higher education or trade schools. Levels of collective efficacy may be increased by incorporating physical structures and places into neighborhoods that encourage community residents to interact with each other while engaging in constructive activities. At this point causal connections have not been determined; future research should attempt to manipulate and objectively measure the community context so that causality and the effectiveness of environmental strategies can be determined.

Additionally, these findings highlight the value and complexity of community-level measurement for promoting community change. For example, some associations between the community context and adolescent problem behaviors were curvilinear; however, the shape of the curve differed depending on the specific combination of the risk/resource and the outcome. This finding makes it more difficult to make recommendations about the magnitude of change that is needed to decrease rates of problems, as changes in the community may change outcomes only if a certain threshold of a risk/resource is surpassed. Future research is needed to replicate these associations and further explore threshold points.

## Limitations

The findings should be considered with a number of caveats. First, though 28 communities is a relatively large number, the study is slightly underpowered. Directional hypotheses were combined with adjustments to the statistical significance criteria; however, it is possible that some findings were overlooked. Further, because of the more generous statistical significance criteria, it is possible that some findings may have been due to chance. Scatterplots and fit indices were carefully examined, models were run without influential cases, and findings were graphed when appropriate as additional safeguards against Type II errors.

The timing of data collection also should be noted. Our goal was for the risk and resource measures to go beyond aggregate measures of a particular cohort of students. To that end, most of the community context measures were collected during early stages of the project (2001–2003), and none of the measures directly overlap with the timing of the student survey data collection (Spring 2005). However, the data on structured activities, alcohol and tobacco outlets, and youth-serving organizations was collected between three to eight months after student participation in the survey. It is possible that the time differentials may have weakened the prediction of youth outcomes. Longitudinal research that assesses multiple measures of context and youth outcomes at multiple time-points is necessary to examine the timing of measurement. Lastly, as this sample is focused on a subset of rural

and small town areas in mid-western and eastern states, these findings can most safely be generalized to similar contexts.

## Conclusion

Results indicated that some independently assessed measures of community context were associated with community rates of early adolescent problem behaviors, with the school district context being the most consistent. Independent measures of the community context are necessary to understand rates of adolescent substance use and delinquency. These findings draw attention to the need to include a wide range of communities, to use conceptually-defined measures of community, to use a multiple method measurement strategy, and to examine the community as a system in order to further investigate the meaning and significance of various community characteristics in the lives of adolescents.

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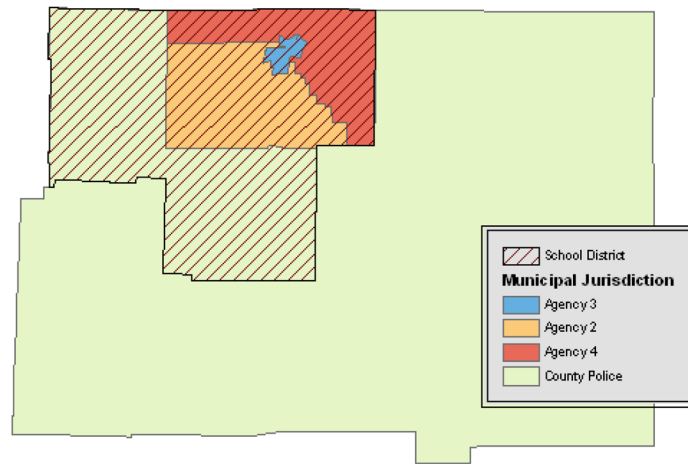
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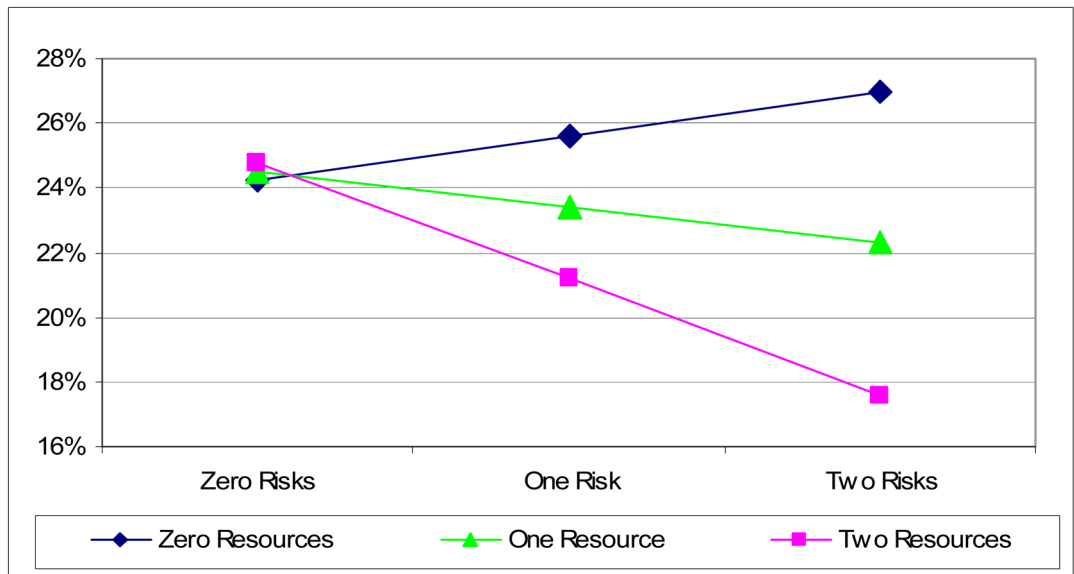
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## Estimating a School District Rate of Crime Using Agency-level Reported Data



Crime Jurisdiction	Square Miles of Jurisdiction	Square Miles within School District	Percent of Area w/in SD	Number of Property Crimes	Weighted Number of Property Crimes
County Police (Agency 1)	836.80	147.02	17.57%	150.67	26.47
Agency 2	55.98	55.98	100.00%	52.33	52.33
Agency 3	3.46	3.46	100.00%	201.00	201.00
Agency 4	46.43	46.43	100.00%	58.00	58.00
Total Number in District					337.80
District Population					21772
Yearly Rate of Property Crimes (Per 100,000)					1551.55

**Figure 1.**  
Illustration of how school district crime rates were created



**Figure 2.** Community rates of adolescent destruction of property predicted by an interaction between the level of risks and the level of resources. The expected community rates of adolescent property destruction as predicted by the interaction between the accumulated risk and accumulated resource measures.

**Table 1**

Listing of measured constructs, data source, time point at which the measure was collected, and descriptive statistics of all scales

Measure	Mean	Std	Min	Max	Sample / Data Source*	Years / Time Point of Data Collection
<b>Community Risks</b>						
Economic Risk						
Community Poverty	6.81	1.93	1.80	10.70	Census / NCES	2000
District Low Income	29.45	8.96	10.40	48.00	School District Reports	2002
Residential Instability	37.65	6.15	25.39	45.51	Census / NCES	2000
Crime Rates						
Violent	284.73	197.35	13.27	674.24	State Uniform Crime Reports	2002, 2003, 2004
Property	2617.19	1357.17	837.68	6208.22	State Uniform Crime Reports	2002, 2003, 2004
Narcotic	267.28	135.46	82.49	511.34	State Uniform Crime Reports	2002, 2003, 2004
Substance Use Environment						
Community Norms	2.61	0.30	2.16	3.31	CL Interviews	2002
Perceived Availability	3.11	0.26	2.69	3.75	CL Interviews	2002
Density of Alcohol Outlets	0.94	0.88	0.07	3.97	State Agencies	2005
Density of Tobacco Outlets	0.59	0.52	0.02	2.02	State Agencies	2005
School District Risk						
District Academic Risk	7.50	3.65	1.00	14.00	School District Reports	2002
School Problems	2.49	0.34	1.62	3.00	CL & AD Interviews	2002
<b>Community Resources</b>						
School Leadership	3.15	0.27	2.63	3.70	CL & AD Interviews	2002
Collective Efficacy	2.85	0.22	2.41	3.32		
Community Attachment	3.31	0.21	2.93	3.73	CL & AD Interviews	2002
Community Initiative	2.39	0.27	1.81	2.90	CL & AD Interviews	2002
Youth Activity Opportunities						
Perceived Availability	2.83	0.26	2.31	3.38	CL, AD, SP, AE Interviews	Oct 2005 – Feb 2006
Rate of Activities	10.72	4.41	3.57	20.97	AE Interviews	Oct 2005 – Feb 2006
Time Spent in Activities	104.07	47.22	23.91	209.39	AE Interviews	2005–2006 School Year
Density of Youth Organizations	0.14	0.13	0.01	0.50	Online Phone Books	2005

Measure	Mean	Std	Min	Max	Sample / Data Source*	Years / Time Point of Data Collection
District Transportation	0.59	0.50	0.00	1.00	SP Interviews	2005
<b>Adolescent Problem Behaviors</b>						
Alcohol Use	0.45	0.07	0.31	0.59	8 <sup>th</sup> Grade Students	2005
Cigarette Use	0.32	0.09	0.17	0.53	8 <sup>th</sup> Grade Students	2005
Aggressive Behavior	0.33	0.05	0.22	0.44	8 <sup>th</sup> Grade Students	2005
Property Destruction	0.21	0.05	0.07	0.29	8 <sup>th</sup> Grade Students	2005

\* Sample abbreviations are as follows: CL = Community leader / AD = Agency Director / SP = School Principal / AE = Activity Expert

Table 2

Zero-order correlations among all measures<sup>^</sup>

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
1. Economic Risk	1.00											
2. Residential Instability	-0.01	1.00										
3. Crime (n = 27)	0.46**	0.46*	1.00									
4. Substance Use Env.	0.42*	-0.45*	0.22	1.00								
5. District Risk	.52**	0.00	.21	.01	1.00							
6. Collective Efficacy	-0.23	0.17	-0.05	-0.35	-0.34	1.00						
7. School Leadership	0.25	-0.44*	0.09	0.52**	-0.08	0.07	1.00					
8. Activity Opportunities	0.12	-0.36	-0.27	0.17	.09	0.30	0.22	1.00				
9. Youth Organizations	0.39*	-0.32	0.27	0.60**	-0.15	-0.12	0.59**	0.07	1.00			
10. Alcohol Use	-0.08	-0.31	-0.34	0.07	-0.06	-0.16	-0.38	0.48**	-0.05	1.00		
11. Cigarette Use	0.36	-0.37	0.00	0.29	.28	-0.36	-0.14	0.24	0.13	0.62**	1.00	
12. Aggressive Behavior	0.12	-0.11	0.02	-0.10	.17	-0.34	-0.18	-0.13	0.19	0.38*	0.43*	1.00
13. Destroy Property	-0.08	-0.08	0.11	-0.07	-0.06	-0.22	-0.13	-0.12	0.12	0.40*	0.53**	0.72**

\*  $p \leq .05$ ;

\*\*  $p \leq .01$ ;

<sup>^</sup> Significance tests are 2-tailed

**Table 3**

Summary table of significant vs. trend associations between predictor variables and outcomes, along with the strength of association.

	Rates of Alcohol Use	Rates of Cigarette Use	Rates of Aggressive Behavior*	Rates of Property Destruction*
Community Risks				
Economic Risk	--	.01	--	--
Economic Risk Sq	--	--	--	--
Residential Instability	--	--	.10	.05
Residential Instability Sq	--	--	--	--
Crime	--	--	--	.10
Crime Sq	--	--	--	--
Substance Use Env	--	--	--	--
Substance Use Env Sq	--	--	--	--
District Risk	--	.01	trend	--
District Risk Sq	--	--	.05	--
Community Resources				
Collective Efficacy	--	.10	trend	--
Collective Efficacy Sq	--	--	--	--
School Leadership	.01	.10	.05	.05
School Leadership Sq	--	--	.05	.05
Youth Organizations	.05	--	--	--
Youth Organizations Sq	.10	--	--	--
Interactions				
Activity Opportunities	--	--	--	--
Transportation	--	--	--	--
Activity × Transportation	--	--	trend	--
Accumulated Risks	--	.10	--	.10
Accumulated Resources	--	--	.10	--
Accum Risks × Accum Res.	--	--	--	.05

\* We controlled for percent male gender in the aggressive behavior and property destruction models because prior research has shown links between externalizing behaviors and gender at the individual level and because the percent of respondents in each community that were male ranged from 42% to 56%. After testing our hypotheses, we computed the models without the control for gender and found two changes in the aggressive behavior models: economic risk was a significant predictor and crime had a nonsignificant trend ( $p=.11$ ) with rates of aggressive behavior without gender in the model. We chose to report the models that included gender as a control because they are more conservative estimates.