From the macro to the micro: A geographic examination of the community context and early adolescent problem behaviors

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Abstract

This study examined how multiple dimensions and levels of the community context associated with early adolescent problem behaviors in rural communities. Four thousand, five hundred and nine eighth-grade students in 28 rural and small town school districts in two states participated in surveys regarding substance use and delinquency in 2005. Locations of alcohol retailers, tobacco retailers, youth-serving organizations, and student residences were geocoded. Associations of the number of proximal alcohol and tobacco retailers, and youth-serving organizations with an early-adolescent problem behavior index were tested in Nonlinear Mixed Models that controlled for multiple district-level and individual characteristics. Multi-level model results demonstrated that the number of alcohol and tobacco retail locations within a one-mile radius of each adolescent's home positively associated with student-reported problem behaviors above and beyond the influence of school district and individual characteristics. Results suggest that the proximal community context added significantly to the district context when understanding the occurrence of early adolescent problem behaviors. Recognizing this variability in geographically determined risk within a community will likely enhance the effectiveness of community prevention activities.

Keywords

Rural; Adolescence; Geographic Information Systems; Substance use; Delinquency; Community or neighborhood context

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The characteristics of school and school district catchment areas are important factors that appear to influence adolescent problem behaviors such as substance abuse (Dent & Biglan, 2004; Dent, Grube, & Biglan, 2005; Ennett, Flewelling, Lindrooth, & Norton, 1997; Lovato et al., 2010; McCarthy et al., 2009). However, research focusing on smaller geographic areas more proximal to an individual's residence – such as city blocks, or census tracts or block groups – also yields significant associations between various aspects of the community context and youth behaviors (Beyers, Bates, Pettit, & Dodge, 2003; Chuang, Cubbin, Ahn, & Winkleby, 2005; Resko et al., 2010; Riva, Apparicio, Gauvin, & Brodeur, 2008; Taylor, 1997). Given that there seems to be significant associations between the community context and adolescent behaviors at multiple yet overlapping levels, this paper focuses on understanding the additive contribution of the proximal community context after accounting for broader community (i.e. school district-level) factors. Understanding the additive contribution of these multiple levels will assist in the planning and implementing of comprehensive and effective community prevention efforts.

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Much of the prior research that focuses on explaining adolescent problem behaviors focuses on the individual-level: how perceived individual risk and protective factors influence individual-reported outcomes (Dodge, 2008; Hawkins, Van Horn, & Arthur, 2004). Recently more work has related community-level factors to community- or individual-level outcomes, but this work has focused mostly on urban settings and relies heavily on census measures, or relies heavily on perception-based measures of the community context (Beyers et al., 2003; Brody et al., 2001; Connell, Gilreath, Aklin, & Brex, 2010; Leventhal & Brooks-Gunn, 2003; Lynam et al., 2000; Mayberry, Espelage, & Koenig, 2009). The current study investigates this issue by focusing on associations among tobacco retailers, alcohol retailers, youth-serving organizations and problem behaviors at two different levels of the community context in a sample of nonmetropolitan middle school youth. This project expands prior work by examining rural and small town contexts and by using independent assessments of an individual's community risk and protective factors when relating to self-reported problem behaviors.

Adolescent Problem Behaviors: Substance Use and Violence

Problem behavior theory considers substance use and aggressive behaviors in early to later adolescence to represent a single domain or syndrome of general problem behavior because of the strong correlations among these behaviors (Donovan & Jessor, 1985). These behaviors are quite prevalent by early adolescence, and they likely have detrimental cumulative consequences. For instance, substance use in these early years increases the risk for addiction (Chassin, Pitts, & Prost, 2002; McGue & Iacono, 2005; Pitkanen, Lyyra, & Pulkkinen, 2005) and can lead to significant social, emotional, educational and physiological problems (Edwards, 1995; National Institute on Alcohol Abuse and Alcoholism, 2003), yet national surveys report that 41% of youth have tried alcohol and 25.9% have tried cigarettes by 8th grade (Johnston, O'Malley, Bachman, & Schulenberg, 2006). Aggressive and/or delinquent behaviors in early adolescence can lead to adult psychopathology (McGue & Iacono, 2005) and difficulties with employment and/or relationships (Abbey & McAuslan, 2004; Caspi, Elder, & Bem, 1987), yet national surveys report that 44% of youth have been violent towards another person, and 29.8% of youth have had their property damaged on school grounds by 9th grade (Centers for Disease Control and Prevention, 2006).

The Rural Context

The current study investigates the links between aspects of the built community environment (i.e. tobacco retailers, alcohol retailers, and youth-serving organizations) with the instance of early adolescent problem behaviors in nonmetropolitan school districts. Investigation of this context is warranted for many reasons. First, this context has largely been ignored by researchers, yet almost one-third of US youth attend school in nonmetropolitan areas (Beeson & Strange, 2003). Second, rates of early use of gateway drugs such as alcohol and tobacco are just as high, and sometimes higher in rural as compared to urban areas (Brown, Schulenberg, Bachman, O'Malley, & Johnston, 2001; Edwards, 1995; Farrell, Anchors, Danish, & Howard, 1992; Johnston et al., 2006). Lastly, though some recent work has focused on non-metropolitan youth (Connell et al., 2010), community contextual factors, including aspects of the built environment, are usually absent in studies of adolescent behaviors within a rural context (e.g., Chopak, Vicary, & Crockett, 1998; Farrell et al., 1992; Griffin, Epstein, Botvin, & Spoth, 2001). Understanding community correlates of adolescent problem behaviors is likely to help explain why certain behaviors seem to persist in certain geographic locations over long periods of time (Shaw & McKay, 1999). There is at present an incomplete understanding of how the rural and small town community context relates to adolescent problem behaviors.

Two Levels of Context

Two levels of the community context are likely to be associated with early adolescent problem behaviors in rural and small town areas. The first is the broad community as defined by school district boundaries. Many rural districts have one middle school and one high school, leading to a common institutional and peer group culture for youth that live in all areas of the district. These characteristics make it likely that students would identify with the whole district, making it an important source of influence in adolescents' lives. Therefore, a strong presence of tobacco and alcohol retailers at this level is likely to convey pro-use, pro-risk taking community norms. Pro-use norms would likely increase the chance that early adolescents would use substances and participate in delinquent behavior (McNeal Jr. & Hansen, 1999). Conversely, youth-serving organizations could be considered an institutional resource (Leventhal & Brooks-Gunn, 2000), and a strong presence of these organizations in a district may provide special social, emotional, physical, and cognitive learning opportunities for youth that would reduce individual and collective risk.

The second level of the rural community context that is likely to be associated with early adolescent problem behaviors is the proximal area around an adolescent's home. Youth begin to spend significantly more time alone and with friends during early adolescence (Larson & Richards, 1991), yet they are unable to drive and public transportation tends to be limited in these areas (Brown & Stommes, 2004). With few options, early adolescent youth are likely to walk or use a bicycle to explore on their own or meet up with friends. These characteristics make it likely that students would spend time and "hang-out" in the area proximal to their homes, making it an important source of influence in their lives. Therefore, a strong presence of alcohol and tobacco retailers proximal to an adolescent's residence may do more than just create norms, it may create opportunities for certain behaviors such as substance use and delinquency (Osgood & Anderson, 2004). Conversely, a strong presence of youth-serving organizations proximal to an adolescent's home could create opportunities for more positive youth behaviors and opportunities to interact with positive role models, decreasing the likelihood that an adolescent would participate in problem behaviors. Hence, an abundance of these structures in the proximal context would likely associate with youth problem behaviors above and beyond their influence in the broader community context.

This research focuses on tobacco retailers, alcohol retailers, and youth-serving organizations as prior research has provided evidence that the presence of these elements associates with emotional and behavioral outcomes in adults or in older adolescents in urban or mixed urban/rural samples. For example, the proximity of recreation resources has associated with physical activity (Diez Roux et al., 2007). The proximity of tobacco retailers has associated with cigarette smoking (Chuang et al., 2005), and locations of alcohol retailers has associated with binge drinking and driving after drinking (Truong & Sturm, 2009), as well as violence, to a degree (Resko et al., 2010). Therefore, it is likely that these or similar elements would be important for early adolescents in rural communities.

The Current Study

The current study expands on prior research by investigating whether the individual youth's proximal experience of community risks and resources is associated with individual problem behaviors after accounting for the broader community context. To this end, the current study examines two hypotheses. First, it is hypothesized that the number of tobacco and alcohol retailers within a 1 mile radius of adolescents' residences will significantly and positively associate with their self-reported problem behaviors after controlling for the district-wide density of tobacco and alcohol retailers. Second, it is hypothesized that the number of youth-serving organizations within a 1 mile radius of adolescents' residences will significantly and

negatively associate with their self-reported problem behaviors after controlling for the district-wide density of youth-serving organizations.

The current study will test hypotheses while predicting the four most common problem behaviors in early adolescents (alcohol use, tobacco use, fighting, and property destruction), and while controlling for age, gender, ethnicity, socioeconomic status, and family structure. Controlling for several demographic characteristics will allow significance tests to better isolate the association between the proximal context and early adolescent problem behaviors.

These sets of variables have been selected for multiple reasons. First, the four most common problem behaviors are most appropriate for this study because it is focused on a normative sample, rather than a high risk sample. Second, these control variables have been selected because prior research has consistently demonstrated links between these characteristics and adolescent problem behaviors (Centers for Disease Control and Prevention, 2006; Johnston et al., 2006; Lerner & Galambos, 1998). Second, socioeconomic status, family structure, and to a degree ethnicity are characteristics that are likely to influence the location of an individual's residence, thereby being potential confounds in place-based analyses. Controlling for these factors will provide a more valid assessment of the community context – adolescent problem behavior link. This study expands prior work by using independently rated measures of the community context, adolescent reports of their own behaviors as the outcome, and an innovative way to create theoretically meaningful measures of the proximal community context in rural and small town communities.

Method

The 28 school districts in the PROSPER project were involved in this study (Spoth, Greenberg, Bierman, & Redmond, 2004). Participating school districts were selected based on 4 criteria: (a) total K-12 school district enrollment was between 1,301–5,200 students in non-metropolitan areas; (b) at least 15% of families were eligible for free or reduced cost lunches; (c) less than half of the population was employed by or attending a university; and (d) communities were not involved in other university-affiliated youth-prevention research projects. The participating universities' Institutional Review Boards authorized the study.

The PROSPER project is a community-level randomized trial of a new dissemination system for empirically validated prevention programs (Spoth et al., 2004). In this model, the Cooperative Extension System coordinates with a representative of the local public school system to build a community team that is connected to appropriate education and prevention resources at the university and state-level by extension prevention coordinators. This community team selects, receives training, and oversees the implementation of empirically validated substance abuse prevention programs for sixth and seventh graders with support from the prevention coordinators and university resources. Outcomes of students, community characteristics, team processes and program sustainability are being followed over time.

Participants

The youth sample in the current study includes the 4509 out of the possible 5003 eighth-grade students that participated in the student survey in 2005 and whose home addresses could be geocoded for an average of 161 students per community (range 73–318). Youth ranged in age from 12.5–16.3 ($M = 14.3$, $SD = 0.42$), 49.3% are male, and 85.6% self-identified as white. The remaining sample consisted of a mix of racial/ethnic minorities (6.0% Hispanic/Latino, 3.2% African American, 1.2% Native American, 1.4% Asian, and 2.8% Other).

Procedures

Student survey—A passive parental consent process with youth assent was used to recruit students for a 45-minute survey during the 2004–2005 school-year. Surveys were administered by teams of two to three individuals that were trained in a standardized protocol. Nearly 90% of the eighth grade students participated in the survey.

Geocoding of address locations—As described below, there are several measures that employ the use of Geographic Information Systems (GIS). GIS software can match specific street address locations to particular latitude and longitude locations in physical space with the help of 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 residential addresses, 87% of the youth activity locations, 95% of the alcohol retail locations and 88% of the tobacco retail locations were successfully geocoded.

Measures

Dependent variable—Congruent with problem behavior theory (Donovan & Jessor, 1985), the dependent variable is a 4-item problem behavior index ($\alpha = .69$) Student responses to four behaviors were coded to be dichotomous (0 = never/1 = at least once), and then summed: (a) lifetime alcohol use ("Have you ever drunk more than just a few sips of alcohol?"); (b) lifetime cigarette use ("Have you ever smoked a cigarette?"); (c) past year aggressive behavior (student has purposefully beat up someone or physically fought with someone because the person made them angry, or thrown objects such as rocks or bottles at people to hurt or scare them); and (d) past year property destruction (student has purposely damaged or destroyed property that did not belong to them within the last 12 months). All items were drawn from National Youth Survey instruments (Elliott, Huizinga, & Ageton, 1985). The time-frame these variables reference is due to their expected normative developmental trajectories. It is expected for substance use to increase over time (Johnston et al., 2006), and the risk of addiction increases with an early age of onset (Chassin et al., 2002); therefore, a rating of lifetime substance use which captures early initiation, is a meaningful measure of delinquency for early adolescents. On the other hand, aggressive behaviors typically decrease with age (Centers for Disease Control and Prevention, 2006); therefore past year, rather than lifetime, measures of aggressive behavior a meaningful measure of adolescent delinquency.

School district-level variables—Three school district-level variables were utilized in analyses. First, the *density of alcohol and tobacco retailers* measures the average number of retail locations of on-premise and off-premise alcohol sales, and sales of tobacco products per 10 km of roadway. Densities per 10 km of roadway were used because they best represent physical availability of the substance (Gruenewald, Ponicki, & Holder, 1993). These data were derived from information provided by the PA Department of Revenue (PA tobacco), PA Liquor Control Board (PA alcohol), and the IA Alcohol Beverages Division (tobacco & alcohol). Density scores were created separately for alcohol and tobacco before combining into a single index for analyses because of their strong correlation ($r = .93$). First, the address locations of these retailers were geocoded. Second, the numbers of alcohol and tobacco retailers that were located within the school district boundaries were summed. Third, the number of alcohol and tobacco retailers within each school district was divided by the number of kilometers of roadway within the district, and then multiplied by 10, to create an average number of alcohol and tobacco retailers per 10 km of roadway within geographical school district boundaries.

Second, the *density of youth-serving organizations* was derived through searches of online phone books (Superpages.com, 2005) and through the YMCA main web-page (YMCA, 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, along with a 30 mile radius as the catchment area. The second search was modified slightly in that it used the zip codes of the students that attend each district as the anchor point from which to search. In this search the zip code was put into the main search page and a slightly smaller, 20-mile radius was used as the catchment area. 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 based search yielded few additional listings. The density variable was created following the same process as described above, resulting in the number of youth serving organizations per 10 km of roadway within geographical school district boundaries.

Third, in order to best test the relative importance of the proximal context, the current study controlled for community *economic risk* because of its importance for a range of youth outcomes (Adler et al., 1994; Chilenski & Greenberg, 2009; Costello, Keeler, & Angold, 2001); economic risk was measured by combining a standardized aggregate of the percent of families within school district boundaries that lived below the poverty threshold (National Center for Education Statistics, 2003) and of the percent of students receiving free or reduced cost lunches. Additionally, as this research is occurring within a 2-state, community-level randomized trial of a dissemination system for evidence-based substance abuse prevention programs, experimental condition (0 = control/1 = intervention) and state (0/1) were utilized as controls.

Proximal community context variables—The two independent variables considered in this paper were created by combining geocoded student residence information with the geocoded locations of alcohol retailers, tobacco retailers, and youth-serving organizations to assess each individual adolescent's experience of the proximal community context. An individual's *proximity to alcohol and tobacco,* and *proximity to youth-serving organizations* was derived using GIS methods that locate the number of these locations within a one mile radius (i.e. "buffer") of the students' residences.

A one-mile radius was chosen as the radial distance for multiple reasons. It is a distance that is likely to be traveled frequently in a rural and small town setting. It is also similar to distances in other studies (Chuang et al., 2005; Kruger, Reischl, & Gee, 2007; McCarthy et al., 2009). Lastly, although this distance yielded a significant amount of between-community variance (17% – 25%), the majority of the variance was attributed to within-community variability (i.e. student). Hence, this distance best describes an individual's proximal experience of the community context.

Student-level control variables—Three student and two family demographic variables were also utilized as controls. The three student demographics include student *age*, *gender* (Girl=0/Boy=1), and *ethnicity* (0=Non-White/1=White). The family demographic variables include *socioeconomic status* and *family structure*. Socioeconomic status was measured with a dichotomous aggregate of student reports of their lunch plans on school days. Low income (1) was equivalent to when students reported receiving a free or reduced lunch on most or all school days. Family structure was summarized into a dichotomous variable from student reports of who they lived with the majority of the time (0=single parent family/1=two parent family).

Analysis Considerations

Because of the large individual-level sample, precautions were taken in order to protect against interpreting individual-level associations found significant by chance. A more strict minimum significance criterion was set so that individual-level analyses utilized a 2-tailed test of $p < .01$ for significance. As the structure of the data had multiple levels and the dependent variable was a count of behaviors with a skewed distribution, two-tailed Nonlinear Mixed Models (NLMM) utilizing Proc NLMIXED that specified a Zero-Inflated Poisson distribution with a random effect were used to test hypotheses in SAS Version 9.2 (Littell, Milliken, Stroup, Wolfinger, & Schabenberger, 2006). This model was decided upon after comparing relative fit statistics of the zero-inflated poisson model to (a) a poisson model with a random effect, (b) a negative binomial model with a random effect, and (c) a two part Hurdle model with a random effect. The zero-inflated poisson model was the best fitting model as it controlled for the overabundance of observed zeros in the dependent variable, and it controlled for a relatively small but significant amount of overdispersion within the data (Littell et al., 2006).

Statistical models also controlled for population density at the school district-level and the census tract-level because more densely populated areas are likely to have more alcohol and tobacco retailers and youth-serving organizations. Controlling for population density thereby better isolated the possible impact of these structures on adolescent problem behaviors by removing any shared variance due to these other place-based factors.

The sample of 4509 youth in the current study had data on all variables of interest *and* all control variables used in the current study. Simple regression analyses were conducted to test for significant differences between this larger group and the smaller group of 494 youth that were missing data on at least one covariate before hypotheses were investigated. Results showed that the final sample of 4509 youth was a slightly lower risk sample than the smaller group of 494 eighth-grade youth. The sample in the current study reported a slightly lower number of problem behaviors ($M = 1.27$, $SD = 1.32$ versus $M = 1.46$, $SD = 1.35$) and had slightly fewer alcohol and tobacco retailers within a 1 mile radius ($M = 16.93$, $SD = 16.23$ versus $M = 17.70$, $SD = 17.45$) than youth that could not be included in final analyses. As a result, after the final, most conservative models were estimated, analyses were rerun omitting family structure, socioeconomic status, and ethnicity as covariates. This strategy allowed testing the effect of the variables of interest with the most conservative model *and* the most representative sample of eighth-grade students in rural and small town areas.

Results

Descriptive Statistics

Descriptive statistics for all measures are presented in Table 1. This sample was relatively low risk, with an average of 6.8% of families living in poverty and an average of 29.5% of families eligible for free or reduced cost lunches in the districts. The sample was well within commonly accepted definitions of rural and small-town areas, as the average population density at the district-level was well under 1000 persons per square mile. Population density was quite variable, however, at the tract level. Approximately 25% of the census tracts within the PROSPER sample had a population density of greater than 2000 individuals per square mile.

At the level of the school district, on average there were 0.77 alcohol and tobacco retailers per every 10 km of roadway, which was equivalent to one alcohol and tobacco retailer per every 13 miles of roadway within the school district boundaries. There were 0.14 youth-serving organizations per every 10 km of roadway, which was equivalent to one youth-serving organization for every 77 miles of roadway within school district boundaries.

In the proximal community context, on average there were 16.93 ($SD = 16.23$) alcohol and tobacco retail locations and 1.81 ($SD = 2.56$) youth serving organizations within the one mile radius (i.e. approximately 3 square miles) of each students' home. Given these averages, it was also important to understand that 931 of the students (20.7%) had zero alcohol and tobacco retail locations within the one mile radius of their homes, and 1,952 of the students (43.3%) had zero youth-serving organizations within the one-mile radius of their homes.

By the spring of their 8th grade year, approximately 43.5% of the students had drunk more than a few sips of alcohol, 30.0% have smoked a cigarette, 32.3% had been physically aggressive towards another person, and 22% had purposely destroyed someone else's property. Overall, the average student had participated in 1.27 ($SD = 1.32$) of the above behaviors, with 1802 of the students (40.0%) reporting participating in zero of the problem behaviors. An estimate of the intra-class correlation revealed a small but significant amount of the variance in problem behaviors was between communities ($\rho_I = .02$, $p < .01$).

Preliminary Analyses

Correlations of proximal community context variables and individual demographics are presented in Table 2. As would be expected, student age and gender did not associate with any of the proximal community context variables. Family structure, race, and low-income all had small but significant associations with each other, and race, family structure, and low-income all had small but significant associations with the proximal community context variables. The strongest associations occurred among the proximal community context variables, tract population density (used as a control in future analyses), the number of proximal alcohol and tobacco retailers, and the number of proximal youth-serving organizations.

Hypothesis Testing

Hypothesis testing proceeded in seven steps in order to best isolate and understand the associations among the independent, control and dependent variables. First, a base model was estimated that included district-level controls for state, intervention status, and community economic risk, and gender as a student-level control variable. Second, the number of proximal alcohol and tobacco retailers was added at the student-level and the density of alcohol and tobacco retailers was added at the district-level to test their effects. Third, the number of proximal youth-serving organizations replaced the number of proximal alcohol and tobacco retailers and the density of youth-serving organizations replaced the density of alcohol and tobacco retailers in the model in order to test their effects. Fourth, each individual-level control variable was added one at a time to the models described in steps two and three. Fifth, both independent variables and their corresponding community-level variable (described in the second and third step) were simultaneously added to the base model. Sixth, both independent variables and their corresponding community-level variables were tested together with all possible community- and individual-level covariates. Seventh, as mentioned above, analyses were conducted with the larger, full sample of 5003 youth with gender as the only individual-level demographic control in order to test the association between the independent variables and dependent variable on the larger, more representative sample of rural youth.

Hypothesis 1: Number of proximal alcohol and tobacco retailers—Results from the above models demonstrated that students who had more alcohol and tobacco retail locations within a one mile radius reported participating in more problem behaviors ($B = 0.005$, $p = .005$), above and beyond the density of retailers at the district-level, state, intervention status, and economic risk. This effect was small but highly significant and it

held in every follow-up model that tested the significance of the effect above and beyond multiple combinations of covariates, except one. The only model where the number of proximal alcohol and tobacco retailers did not significantly associate with the number of reported problem behaviors was the model that included tract population density. These two variables, when alone in the model, shared too much variance, therefore the number of proximal retailers ($B = 0.002$, $p = .13$) and tract density ($B = 0.00001$, $p = 0.31$) did not surpass significance. See Table 3 for the final estimates computed in the full model. In practical terms, having 50 alcohol and tobacco retail locations nearby would predict approximately 0.52 of a problem behavior; however, with the nonlinear nature of the association, the occurrence of problem behaviors increases at a greater rate as the occurrence of retail locations increases (see Figure 1). This association did not change in the last model, which tested the association in the larger, more representative sample with fewer covariates.

Hypothesis 2: Number of proximal youth-serving organizations—Results from the above models demonstrated that students who had more youth-serving organizations within a one mile radius did not report participating in fewer problem behaviors; this effect was initially not in the expected direction, nor was it significant ($B = 0.003$, $p = .66$). The significance level and direction of this association changed slightly during the follow-up tests, indicating a possible suppressed effect, yet the effect consistently remained above this study's minimal statistical significance criterion. The effect of proximal youth-serving organizations ($B = -0.02$, $p = 0.02$) was in the expected direction and stronger after tract density was included in the model as a control, and it became slightly stronger after the number of proximal alcohol and tobacco retailers was also included ($B = -0.02$, $p = 0.01$). Results for the final model, which included all student-level and district-level controls as well as both proximity variables are located in Table 3. This association did not change in the last model, which tested the association in the larger, more representative sample with fewer covariates.

Discussion

This study investigated the added contribution of the proximal geographic context in predicting individual youth's reported problem behaviors. The findings indicate that aspects of the proximal community context predict youth problem behavior even after accounting for the broader community context. As in prior research that focused on adult and adolescent attitudes and behaviors in mostly urban environments (Chuang et al., 2005; Diez Roux et al., 2007; Kruger et al., 2007; Resko et al., 2010; Truong & Sturm, 2009), early adolescents' proximity to alcohol and tobacco positively relates to their level of problem behaviors in rural and small town areas. This association holds even after accounting for multiple district-level risk factors and individual demographic factors. In addition, the association between the proximity to youth-serving organizations and youth problem behaviors is in the expected direction but is not statistically significant.

Community demographics indicate that the sample in this study is relatively representative of rural and small town areas in the US (Johnson, 2006) and that this sample would generally be considered a low risk sample. It is less diverse and less impoverished than a representative United States sample (US Census, 2000), and more students live in dual-parent households compared to national averages (Population Resource Center, 2004). However, observed rates of substance use and delinquency are relatively similar to national averages, and in some cases, rates of these behaviors are a bit higher than national averages. Hence, these findings generalize most appropriately to similar rural and small town communities with relatively average to high levels of problem behaviors.

Prior theoretical work assists in understanding how these influences may operate (Leventhal & Brooks-Gunn, 2000; McNeal Jr. & Hansen, 1999; Osgood & Anderson, 2004). Norm-setting theory suggests that students that live in an environmental context that has an abundance of alcohol and tobacco retailers may perceive that community norms are more accepting of adolescent substance use and delinquency. Routine activities theory suggests that having many alcohol and tobacco retail locations nearby may create an opportunity for risk-taking and unsupervised adolescents to use substances and engage in other delinquent behaviors. Early adolescents may also spend more of their unsupervised time in these higher-risk areas as they may function as "hang-out" points for groups of mixed-age youth. Early adolescents could then gain access to these substances and may be pressured to experiment with alcohol and tobacco if older adolescents are able to purchase these substances without identification.

This is the first study that has examined these issues in an exclusively rural and small town population. There are characteristics unique to the rural environment that may be important to consider and would likely reinforce the above mechanisms. The average commute time has increased by as much as 20% over the last two decades for residents in some rural areas (Center for Rural Pennsylvania, September/October 2009). Because of this, it is likely that early adolescent youth would be left unsupervised or under the care of an older sibling before and/or after school. School districts in rural and small town areas also typically have smaller grade-level cohorts, hence a relatively small pool of potential same-age friends. Both characteristics may encourage early adolescents in rural areas to socialize in mixed-aged peer groups that include older adolescents, which is likely to support early experimentation with substance use and delinquency.

Though a small effect, it is important to remember that these community characteristics do not operate in a vacuum. When combined with average levels of individual and/or family risk, an above average risk community environment could be just enough to move an individual's propensity for problem behaviors into reality.

Somewhat surprisingly, having a higher number of youth-serving organizations proximal to a youth's residence was not a significant contributor when predicting self-reported problem behaviors. These findings were well-within conventional levels of statistical significance but did not surpass the more stringent level set for this study due to the large individual-level sample. In this study, there are many more alcohol and tobacco retailers than youth-serving organizations in every community. Though a similar ratio is likely true across the US, this discrepancy is likely larger in rural and small town areas. Rural and small town communities tend to be underserved by nonprofit human- and social-service organizations. The tax base needed to support these organizations and activities is typically not available, and foundations that would give grants to support this type of work are limited. As a result, it is likely that the affect of proximal youth-serving organizations on early adolescent problem behaviors, though of some importance, is of lesser importance compared to more negative influences such as access points for tobacco and alcohol.

In addition, the results including proximal youth-serving organizations suggest that tract density and the number of proximal alcohol and tobacco retailers act as suppressors in the proximal youth-serving organization – youth problem behavior association. This is not surprising given that proximal youth-serving organizations, tract density, and proximal alcohol and tobacco retailers all have positive associations with each other. Once the shared variance among these variables is accounted for, the expected negative association between youth-serving organizations and problem behaviors becomes apparent.

Implication for Prevention and Intervention

The findings of this study suggest three important considerations for communities. First, the effectiveness of prevention efforts may be increased if the smaller geographic contexts within rural and small town school districts are considered when making decisions, implementing policies, and implementing programs. The school districts in this sample encompass multiple boroughs, townships, small towns, and/or incorporated areas, and it is common for school districts to cross official and unofficial boundaries. These analyses suggest some meaningful contextual differences exist within district boundaries. Assessing and addressing these differential needs may improve the effectiveness of community collaborative prevention efforts.

In addition, these findings have direct policy implications, as they would suggest that rationing the number and location of these alcohol retailers, tobacco retailers, and youth-serving organizations may be an appropriate community prevention policy and strategy. These community characteristics have population-level implications. In other words, because of the pervasiveness of these organizations in our culture, despite a small effect size, even a small change in alcohol and tobacco retail locations would be likely to have a large effect on the target population. In addition, this analysis only considered the actual presence of the business and/or organization, rather than characteristics of the businesses and/or organizations. It is likely that the impact of these businesses or organizations would become even stronger when considering their characteristics.

Lastly, these findings suggest that community collaborative prevention efforts may want to consider aspects of the built environment when planning and implementing community change efforts. The use of visual tools would likely help in this process. Visual tools can be created by working with a GIS specialist, or through an activity such as the eco-map (Scheve, Perkins, Mincemoyer, & Welsh, 2006). Using appropriate visual tools has been crucial in the past to communicate information (Tufte, 1997). It is likely that creating maps of important community risks, resources, and the distribution of the population would assist collaborative boards in understanding the needs of different areas. Empirical research testing this procedure is necessary.

Once the needs of the broader community and its subsections are understood, prevention boards could make more effective recommendations, and specific factors could be targeted for intervention. An example of how a community could use mapping to assist with planning for a voluntary community-wide universal prevention programs is located in Figure 2. The distribution of the population and the distribution of risks suggest the maximum benefit of a prevention program will be realized when recruitment of youth and families is targeted in the highest risk areas that also have the largest population. Gaps in service delivery are likely more easily identified if these tools are used continually in the plan, implement, and evaluate process.

Limitations

These findings should be considered with a number of caveats. This sample is focused on a subset of rural and small town areas in mid-western and eastern states, as a result, these findings can most safely be generalized to similar contexts. These data are cross-sectional and therefore the findings can best describe simultaneous associations among the included measures rather than a temporal ordering and causality.

Additionally, the large student-level sample could make it more likely to make a Type I error, though adjustments were made to the statistical significance criterion and multi-level models were used in order to provide some protection against this occurrence. Given that the dependent variable was an ordered outcome with five categories, another possible statistical

model would be a multi-level ordinal logistic regression. However, a 5-level dependent variable within this size of a multi-level sample with this large number of predictors would likely too complicated to converge within present software capabilities; as a result, four different models were tested and compared, and the resulting model did account for the inflated number of zeros observed within the dependent variable and overdispersion.

This study also used a new technique to collect data on youth-serving organizations. The reliability of this technique has not been well established, and it is possible that youth-serving organizations may be informal, and not picked up by the method used in this study. The multilevel analysis strategy and controlling for state would provide some degree of protection in the event that there were systematic differences in the reporting and collecting of this information between the two states and/or between communities, but any affect on the results is unknown.

Lastly, two conceptual issues deserve mentioning. Though present analyses controlled for local population density, they are unable to rule out the possibility that youth in heavily populated rural areas may be more likely to engage in problem behaviors simply when more youth are nearby, and this study was conducted within the context of a larger study whose intent was to study the process and effects of a new community prevention system.

Summary

The present study integrated current research and theory on the community context to examine how different community characteristics at two geographic levels are associated with the occurrence of adolescent problem behaviors. The present findings indicate that it is important to consider the individual youth's proximal community context in addition to features of risk at the level of school districts in rural and small town areas. Assessing the local geographic area within which a student lives adds unique prediction to their participation in problem behaviors. Future research should continue to examine the associations of these and other geographic aspects of the community context as well as community-level interventions aimed at changing this relationship.

Acknowledgments

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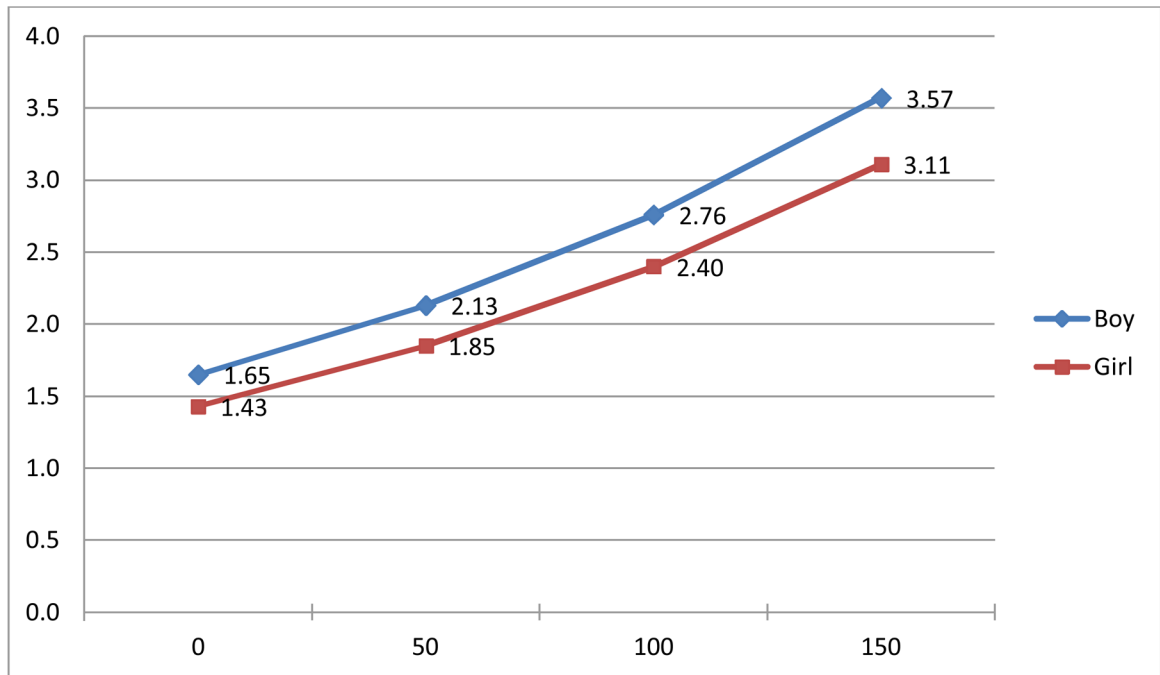
Figure 1.
Predicted values of the number of problem behaviors given different levels of the number of proximal alcohol and tobacco retailers, for a boy and a girl, both 14 years of age, white and not low-income.
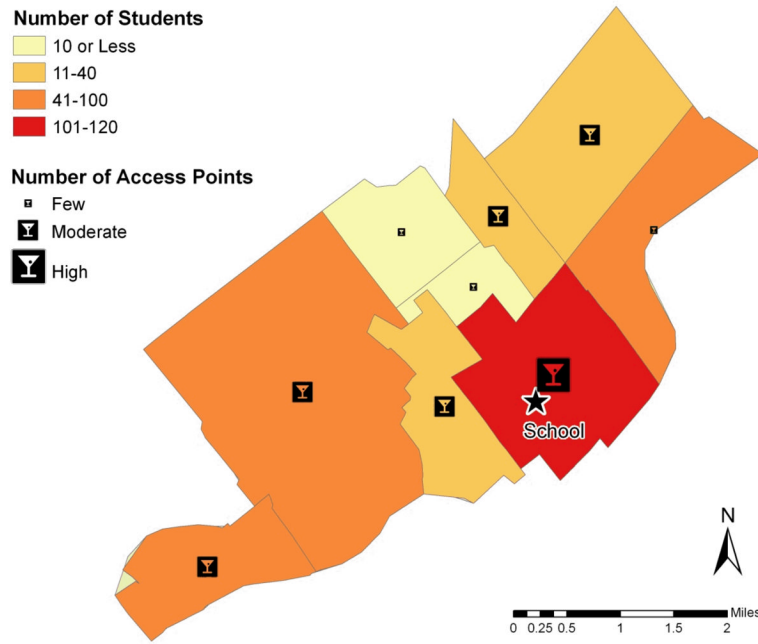
Figure 2.
Example school district divided into subsections, with the distribution of the population and one example risk level depicted. In this example, the subsections are municipal areas.

Table 1

Descriptive statistics of sub-scales and community context variables

Scale	Percent/Mean	SD	Min	Max	Lower CL	Upper CL
Student Demographics						
Age	14.3	0.42	12.5	16.3	14.29	14.31
Male	49.3%				48.1%	50.9%
Non-White	14.4%				13.6%	15.6%
Low Income	26.8%				25.7%	28.3%
Single Parent Family	22.8%				21.9%	24.1%
Tract Population Density	1398.64	1964.37	8.39	8955.60	1377.55	1476.87
Broad Community Context (i.e., School District)						
District Population Density	265.01	287.59	16.74	1226.16	135.56	376.59
District Economic Risk (standardized average)	0.00	0.92	−2.36	1.55	na	na
Community Poverty	6.81	1.93	1.80	10.70	6.07	7.56
District Low Income	29.45	8.96	10.40	48.00	25.98	32.93
District Density of Alcohol & Tobacco Retailers	0.77	0.69	0.08	3.00	0.50	1.03
District Density of Youth-serving Organizations	0.14	0.13	0.01	0.50	0.09	0.19
Proximal Community Context						
Proximal Alcohol and Tobacco Retailers	16.93	16.23	0.00	77.00	16.55	17.46
Proximal Youth-serving Organizations	1.81	2.56	0.00	18.00	1.76	1.90
Student Outcomes						
Problem Behavior Index	1.27	1.32	0.00	4.00	1.25	1.32
Lifetime Alcohol Use	43.5%				42.4%	45.2%
Lifetime Cigarette Use	30.0%				29.4%	32.0%
Past Year Aggressive Behavior	32.3%				31.6%	34.2%
Past Year Property Destruction	21.1%				20.3%	22.6%

Table 2

Simple correlations with 95% confidence intervals (lower limit, upper limit) among student demographics and proximal community context variables

	1.	2.	3.	4.	5.	6.	7.	8.
1. Age	---							
2. Gender	0.14***(.11, .17)	---						
3. Race	0.01 (−.02, .03)	−0.01 (−.04, .02)	---					
4. Family Structure	−0.04 (−.06, .01)	0.02 (−.01, .05)	0.05**(.02, .08)	---				
5. Low Income	0.06***(.02, .09)	−0.01 (−.04, .02)	−0.19***(−.22, −.16)	−0.25***(−.27, −.22)	---			
6. Tract Population Density	0.03 (.00, .05)	0.03 (.00, .06)	−0.05 (−.08, −.02)	−0.09***(−.12, −.06)	0.14***(.11, .16)	---		
7. Number of Proximal Alcohol & Tobacco Retailers	0.01 (−.02, .04)	0.02 (−.01, .05)	−0.10***(−.13, −.07)	−0.11***(−.14, −.08)	0.19***(.16, .22)	0.64***(.63, .66)	---	
8. Number of Proximal Youth-serving Organizations	0.02 (−.01, .05)	0.02 (−.01, .05)	−0.12***(−.15, −.09)	−0.08***(−.11, −.06)	0.09***(.06, .12)	0.50***(.48, .52)	0.72***(.71, .74)	---

*
$p < .01$;

**
$p <= .001$;

***
$p <= .0001$

Table 3

Final Nonliner Mixed Model results with all covariates predicting adolescent problem behavior index with proximal community characteristics

	Beta (*B*)	SE *B*	Lower 95% CI	Upper 95% CI
Intercept	−1.5110	0.4874 **	−2.4774	−0.5446
Control Variables				
Community-level				
State	0.1797	0.0358 ****	0.1088	0.2506
Intervention	−0.0221	0.0309	−0.0832	0.0391
Economic Risk	0.0279	0.0254	−0.0223	0.0782
Availability of Substances	−0.0853	0.0598	−0.2039	0.0333
Youth-serving Organizations	−0.0907	0.2730	−0.6320	0.4505
District Population Density	−0.00003	0.00009	−0.0002	0.0001
Student-level				
Gender	0.1391	0.0301 ****	0.0794	0.1988
Age	0.1313	0.0334 ***	0.0650	0.1976
Ethnicity	0.0249	0.0438	−0.6205	0.1118
Socioeconomic Status	0.0626	0.0335	−0.0039	0.1291
Family Structure	−0.2263	0.0334 ****	−0.2925	−0.1600
Tract Population Density	0.00001	0.00001	−0.00001	0.00004
Independent Variables				
Proximal Alcohol and tobacco Retailers	0.0052	0.0017 **	0.0018	0.0085
Youth-serving Organizations	−0.0242	0.0094 *	−0.0428	−0.0056

*
p < .05;

**
p < .01;

***
p < .001;

****
p < .0001