Published in final edited form as:

Am J Addict. 2013 May ; 22(3): 188–196. doi:10.1111/j.1521-0391.2012.12023.x.

Urban-Rural Differentials: A Spatial Analysis of Alabama Students' Recent Alcohol Use and Marijuana Use

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Abstract

Background and Objectives—This study of Alabama public school students sought urban-rural differences in social and spatial mechanisms connecting structural factors to recent use of alcohol and marijuana.

Methods—Its dataset comprised a state-sponsored 2002 need-assessment survey of Alabama students; Alabama education department data; U. S. Census data; and alcohol-outlet locations listed by Alabama's Alcoholic Beverage Control Board. It measured structural-disadvantage factors (population disadvantages, community instability, alcohol-outlet density), social-organization factors (protective role of community, protective role of school), and recent-use factors. Using Geographic Information Systems (GIS), it generated maps of school catchment areas (SCAs)—the units of analysis for the study—that outline spatial patterns (across areas deemed *urban* or *rural*) of students' recent use of alcohol and marijuana.

Results—In the final sample of 370 SCAs, significant urban-versus-rural differences were observed for certain structural factors and in how these factors were associated with substance use. These differences aside, spatial analysis weighing the SCAs' particular geographic characteristics suggested location's importance, showing that a school playing a strong protective role significantly reduced not just its own students' recent substance use, but that of students in neighboring SCAs as well.

Conclusions and Scientific Significance—The findings show students' recent use of alcohol and marijuana are associated with characteristics of the environment.

With the advent of new research methods in geography, researchers in other fields have begun exploring *location* as a factor in phenomena not traditionally viewed as geographic: for instance, certain aspects of human behavior ¹. Our study therefore took a geographic *spatial analysis* approach to evaluating student substance use. Models we employed to explain students' behavior incorporated the students' locations as well as more typical social factors ². Location provides important context for adolescent substance use: "Where" adolescents live and go to school implies "why" they use substances ³. The "why" question comprises structural and social factors associated with different locations, including substances' potential availability in each location and the opportunity for, as well as the discouragement of, substance use which characterizes each location ^{4, 5}. *Structural and social factors* can be defined as patterns of social arrangement and other conditions. Some such patterns pose disadvantages, sometimes constituting a risk of deviance or crime. For

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Declaration of Interest:

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of this paper.

example, high rates of poverty, residential instability, and female-headed households suggest weak social organization and weak social networks. Weak social links diminish the sense of responsibility for others. In weakly organized, weakly networked neighborhoods, witnesses to crimes may keep quiet and adults may not involve themselves in the conflicts or other behaviors of “other people’s children”; lack of this type of informal guardianship leads to increased deviance and crime^{6, 7–8}.

That differential structural and social factors characterize urban versus rural locations is well documented. The present study aimed to document hypothesized differences in *how* structural-disadvantage and social-organization factors exert the impacts they do on alcohol- and marijuana-use rates of public-school students in urban versus rural Alabama. Using population disadvantages, community instability, and alcohol-outlet density to indicate structural disadvantage, and using community and school to indicate social organization, the study was meant to evaluate whether and how students’ alcohol and marijuana use are explained by possible protective social-organization factors in locations having dissimilar levels of disadvantages built into the social structure.

Admittedly, research findings on the role of urban versus rural location in adolescent substance use are inconsistent. Some suggest adolescents in rural areas are, in recent years, as or more likely than urban counterparts to use substances^{9–12}. Others continue to identify comparatively more adolescent substance use in urban areas—although even these findings suggest the gap is narrowing¹³. The studies’ non-uniform definitions of *urban* and varying levels of analysis (i.e., individual-level, collective-level) account for some of the inconsistency^{14, 15}. But it is not necessary to know if these adolescent-substance-use rates are converging in order to know that, with few exceptions, the social mechanisms underlying levels of adolescent substance use in urban locations versus rural ones have not received much scientific attention^{16, 17}.

To date, explanations of community rates of deviance have concentrated on characteristics of the population of the community and characteristics of the location, including both structural-disadvantage and social-organization factors⁴. Researchers applying social disorganization theory (which focuses on the relationship between population characteristics and crime) have observed heightened risk of deviance in (typically urban) neighborhoods with a high level of poverty and residential instability plus minimal collective efficacy (encompassing social cohesion and community control of residents’ behavior)^{18, 19}. Routine activity theory has also been applied, in studies that emphasize the crucial roles of (a) opportunity for deviance and (b) absence of capable guardians impeding deviance, and that postulate characteristics of locations which may promote these phenomena (and thus deviance)^{20, 21}. Within the specific research field of adolescent substance use, both theories place higher levels of adolescent substance use in areas marked by extensive population disadvantages, residential instability, high alcohol-outlet density, and weak social organization and cohesion deriving from community or school^{4, 8, 22}. Given that social contacts and exchanges happen across communities and locations (e.g., people commute to work, visit friends at a distance, patronize bars and restaurants regardless of proximity), researchers have extended community contextualization of adolescent substance use to neighboring communities. They have in fact measured a spatial diffusion process by which substance-using behavior moves from location to location²³.

The present study accepted that rural and urban locations often exhibit distinct structural-disadvantage and social-organization characteristics; it also assumed the operation of a spatial diffusion process helping explain adolescent substance use. The study’s aim was to compare, for urban versus rural areas, the social mechanisms that might link structural-disadvantage and social-organization characteristics to rates of student substance use. Two

hypotheses were developed for the study: first, that each type of characteristic would exhibit unique associations with alcohol- and marijuana-use rates depending on whether adolescents lived in rural or urban locations; and second, that characteristics' presence in neighboring communities would relate to a given focal community's substance-use rates differently for urban areas than for rural areas.

METHODS

The present study's data came from the Alabama Student Survey, which was conducted in spring 2002 by the Alabama Department of Mental Health, and from some additional print and electronic resources including U. S. Census data, the Alabama State Department of Education (ALSDE) website (<http://www.alsde.edu/html/home.asp>), and a listing of locations of alcohol outlets from the Alabama Alcoholic Beverage Control Board²⁴. The Alabama Student Survey had a probability-based sample of 92,822 students in grades six through 12, attending a total of 592 Alabama public schools; average respondent age was 14.5 years ($SD = 2.0$). Surrounding each of the 592 schools was its school catchment area (SCA), comprising the residential areas from which students were assigned to the school. Most often, one SCA covered all grade levels housed within its school; occasionally, however, a single school claimed more than one SCA, because it housed a range of grade levels and served a larger area for one or more grades. No sufficiently detailed comprehensive listing of Alabama school catchments existed, so we obtained catchment maps or bus route maps from each school separately, except in instances in which unavailability of such maps required us to estimate catchment boundaries. We solicited the catchment/bus route maps early in our study's course, in 2008 and 2009. However, this was still some years following the collection of data by the Alabama Student Survey, in 2002. Our catchment/bus route maps thus date from a time not strictly corresponding to the period of collection of students' data. We do not believe that major changes in the makeup of school catchments occurred during the interval. Indeed, catchments tended to be of such permanency that documenting them repeatedly involved visiting a school to photograph the old map that was affixed to or even painted on the school walls.

Taking the street addresses of Alabama public schools from the ALSDE website, we geocoded school catchments—that is, we plotted their precise locations with latitude/longitude coordinates—using ArcGIS 9.3 Geographic Information Systems (GIS) software²⁵. GIS is an important tool that comprises software products able to integrate geographic information with visual display, modeling, and data analysis, and that enables data analyses to simultaneously examine both “where” and “why” aspects² of phenomena. We further used GIS software to determine each SCA's correspondence to one or more census tracts. We aggregated individual-level data in order to measure social-organization factors and student substance use within each SCA. Then, we linked data from the 2000 census to each SCA, to measure its structural factors. In all, 370 SCAs were included in our multivariate data analyses.

Measures. We developed 2 outcome variables for this study, 30-day alcohol-use rate and 30-day marijuana-use rate. The Alabama Student Survey had asked respondents to report the number of occasions over the past 30 days on which they had used alcohol (beer, wine, or hard liquor) and marijuana. Responses to be used were (1) 0 occasions, (2) 1–2 occasions, (3) 3–5 occasions, (4) 6–9 occasions, (5) 10–19 occasions, (6) 20–39 occasions, and (7) at least 40 occasions. To obtain final measures for each respondent, his/her scores for each substance category were summed. Apparent skewing of the distributions of the outcome variables prompted us to perform natural log transformations for these variables.

During development of these 2 outcomes at the collective level, we needed to take into account the number of students sampled in each SCA. Two steps were required to do so. First, with HLM6 software we adjusted the predicted values of the 2 individual-level substance-use outcomes for each student, reflecting the size of the sample from the pertinent SCA. Then, we aggregated scores and calculated each SCA-wide average score for student 30-day alcohol use and for student 30-day marijuana use.

Our study's independent variables comprised 2 social-organization factors (protective role of school, protective role of community) and a series of structural-disadvantage variables describing population disadvantages, community instability, and alcohol-outlet density. The social-organization factors outline collective actions taken by the school or community to promote prosocial behavior of students. Using individual students' responses to Alabama Student Survey items indicating these collective actions, 4 indexes were developed. To measure school's protective role, students were asked, in a total of 9 items, whether they agreed that prosocial opportunities and rewards were available at school through class projects, group decisions, extracurricular activities, notice or praise from teachers, and a feeling of safety at school. To measure community's protective role, we initially captured individual responses indicating, over a total of 8 items, the students' agreement (or lack of it) that adults were available to talk with, sports teams and social clubs provided constructive ways to spend their time, and their neighbors encouraged, noticed, and were proud of their accomplishments and good qualities. For both school and community measures, we summed the individual scores of the students for each index, and then summed the index scores separately for the school and community in each SCA. We then aggregated and averaged these 2 separate scores to generate the SCA's collective measures. At the individual level, each protective variable was associated with moderate to high reliability scores, the Alpha scores ranging from .62 to .82. A total of 17 items were used in formulating the 2 social-organization or "protective role" factors; therefore, where the 2 factors were concerned, a single missing answer on any of the 17 items constituted missing data. In cases in which such data was missing, we relied on mean substitution to describe protective roles. Mean substitution is an adequate and commonly used method of reducing missing data, when available information is insufficient to allow more-sophisticated imputation of data.

We measured the following structural characteristics for each SCA: percentage of African American residents in 2000; percentage of White residents in 2000 (reverse coded); percentage of female-headed single-parent families (children under age 18) in 2000; percentage of population living below poverty level in 2000; SCA's location in a "Black Belt" county; percentage of population 15–18 years old in 2000; percentage of families residing in one and the same domicile from 1995 to 2000 (reverse coded); percentage of population 25 years and older having a college degree in 2000; percentage of population 25 years and older having a high school diploma in 2000. Exploratory factor analysis guided development of (a) a population-disadvantages factor and (b) a community-instability factor; to fashion the 2 factors, we used the first 6 and the final 3 structural characteristics, respectively, from this list. Locales in which teenagers, the poor, African Americans, and female-headed households are concentrated represent social arrangements without much access to political or social resources; this leads to a socially disadvantaged population and high rates of deviance and crime in the locale²⁶. Locales in which residents are well educated and repeatedly change addresses are likely to have a high percentage of renters and to constitute relatively unstable communities⁸.

We used GIS techniques again, with street addresses of alcohol outlets as recorded by the Alabama Alcoholic Beverage Control Board, to determine for each square kilometer (1 kilometer² = .39 mile²) the number of (a) bars, (b) retail stores, and (c) restaurants offering patrons alcoholic beverages; this measured the alcohol-outlet density of each SCA. The

board provided us with addresses of all on- and off-premises alcohol outlets licensed during 2001 and 2003 (approximately contemporaneous with the 2002 administration of the Alabama Student Survey). Ultimately, we obtained an average of the number of outlets licensed during the 2 years. We also obtained an overall geocode rate of 77%, meaning we were able to plot more than three-fourths of the addresses provided by the board. In a state as rural as Alabama is, such a value can be considered a fairly successful outcome of geocoding. Nearly all the addresses we could not geocode were in remote areas and unlikely to fall within any school catchment.

To measure the 3 structural constructs of interest in our study, we added together standardized scores for the relevant measures, obtaining one score for population disadvantages, one for community instability, and one for the 3 alcohol-outlet variables (number of bars, stores, restaurants). The Alpha for our population-disadvantages measure was 0.92; for our community-instability measure was 0.80; and for the alcohol-outlet-density measure was 0.92. Both the Alabama Student Survey dataset and several measures used in the present study had been employed in earlier studies of drug use and other delinquent behavior^{22,27}.

Each SCA's urbanness was indicated by the percentage of its population living in an urban neighborhood in 2000. Based on the average across all SCAs—35% urban population—we collapsed the urbanness variables into (a) urban SCA having above 35% urban population and (b) rural SCA having no more than 35% urban population.

Data Analysis

To include a spatial diffusion process in our model, we first used GeoDA spatial analysis software²⁸ and ArcGIS to construct a catchment-by-catchment spatial weight matrix based on the rook definition: a 1 indicated that two SCAs shared a boundary, while a 0 indicated that two SCAs were not contiguous¹⁹. We created a special lag term, W_y , for each outcome, which represented the weighted average of the student-substance-use variables (30-day alcohol-use rate and 30-day marijuana-use rate, each adjusted) for neighboring SCAs²⁹. We also calculated W_x , a weighted average of each of the independent variables measured in neighboring SCAs. Next, we used SPSS and a 2-stage least squares (2SLS) approach to develop a *spatial lag model* of student substance use, while estimating the spatial autoregressive parameter characterizing substance-use rates and evaluating whether environment-based factors (observed or unobserved) in one SCA affected surrounding SCAs' student-substance-use rates. We used stage 1 to remove the correlation between W_y and the error term of the substance-use rate variable, by including all the spatial lag terms of the independent variables (W_x 's) as instrumental variables^{30,31}. Stage 2 comprised inclusion of the spatial lag term (W_y) as one independent variable in the final regression of adjusted student-substance-use rates, run separately for the rural and urban SCAs.

Rather than include the spatial lag term of the outcome during stage 2, we developed a second model incorporating spatial lag terms for the observed independent variables, in order to predict student-substance-use outcomes. We used regular regression techniques to analyze this second model. While the spatial lag terms for the independent variables were strongly related to our independent variables, multicollinearity did not appear to pose extreme difficulty during the final analyses (the lowest tolerance value in the urban SCA analyses was .33; in the rural SCA analyses, .19).

Our final step was to conduct *t*-tests comparing coefficients obtained for urban SCAs to coefficients obtained for rural SCAs, to learn whether differential spatial patterning characterizes urban and rural areas. The *t*-tests were also expected to help us see whether the

characteristics of neighboring communities affected adolescent substance-use rates differently in rural communities than in urban communities.

RESULTS

Table 1 shows the descriptive statistics and correlations of all included variables, separately for urban and rural SCAs. Correlations for the urban SCAs are located on the left corner below the diagonal, while correlations for the rural SCAs are found above the diagonal. We used *t*-tests to evaluate, for all these variables, the mean differences in rural versus urban measures; we found no statistically significant differences for 30-day alcohol-use rate or 30-day marijuana-use rate. Statistically significant differences were found for the 3 independent variables: community instability, alcohol-outlet density, and community's protective role; specifically, urban SCAs were associated with higher levels of community instability and denser alcohol outlets, while rural SCAs were associated with higher measures for community's protective role.

As expected, social-organization factors were found to be negatively associated with substance-use rates. We found very interesting the unexpected finding that, for both urban and rural catchments, a high score for population disadvantages appeared negatively related to community instability. Several correlations were found to differ by type of location (urban, rural) when it came to achieving statistical significance. For example, as an urban population's disadvantages increased, so did the measure of alcohol-outlet density in that population's community. For rural SCAs, a negative relationship was observed between population disadvantages and alcohol-outlet density. While in our rural SCAs level of instability and community's protective role were, as expected, negatively related, no similar significant relationship was observed for urban SCAs. In addition, in rural catchments only, higher alcohol-outlet density was found to be negatively related to school's protective role; and in urban catchments only, to community's protective role. Greater alcohol-outlet density was also found to be positively associated with rural students' 30-day marijuana-use rate, but showed no statistically significant relationship with urban students' rate.

To elaborate both structural factors' and spatial diffusion's responsibility for the 2 outcomes, we placed in our first model the spatial lag term plus all the structural factors for the outcome variable; and we placed in our second model the spatial lag terms for all the structural factors plus all the structural factors for, separately, the urban and rural locations. Tables 2 and 3 show the results for the 30-day alcohol- and marijuana-use rates, respectively. In explaining alcohol-use rate via the first model, the 2 social-organization factors and the outcome variable's spatial lag term (*Wy*) were found to be significant for both rural and urban SCAs (see Table 2). As expected, higher measures for school's protective role and community's protective role were associated with lower rates of student alcohol use. The significant spatial lag term from the first model indicates the presence of spatial diffusion; specifically, a high level of recent student alcohol use in neighboring catchments was associated with a high level of recent student alcohol use in a focal catchment.

For both rural and urban SCAs, social-organization factors remained significant when, in the second model, all the spatial lag terms belonging to the structural factors were included. The spatial lag term for protective role of school proved significant for both locations. A further significant result was found for rural SCAs only. It was the positive relationship between community instability and recent alcohol-use rate. When *t*-tests were performed comparing coefficients found for urban and rural SCAs, only one significant result was obtained; it appears in Table 2, in boldfaced, underlined figures. Community instability's positive

impact on student alcohol use was significantly stronger for rural than urban catchments ($t = -2.07, p < .05$).

Results in Table 3 show that, in the first model, 30-day student-marijuana-use rates were significantly associated with the spatial lag term of the outcome variable and the 2 social-organization measures, for urban and for rural catchments. When the independent variables' spatial lag terms were used to estimate the spatial process, we found that, in urban catchments, alcohol-outlet density's spatial lag term and protective role of school's spatial lag term were significantly related to students' recent marijuana use. In addition, the 2 social-organization factors were significantly related to urban students' recent marijuana use. In rural SCAs, community instability and the 2 social-organization factors were found to be associated with students' marijuana use. In the second model, however, no spatial lag term was found to be significant for rural students. When t -tests were performed, 3 significant results appeared. The first, pertaining only to rural SCAs, was that the relationship between community instability and student marijuana use was significantly stronger ($t = -2.04, p < .05$). The second, this time pertaining only to urban SCAs, was that the outcome's spatial lag term was much stronger ($t = 2.04, p < .05$). The third was that the negative impact made on marijuana use by school's protective role in neighboring catchments was a much stronger negative impact in the urban catchments ($t = -2.75, p < .01$).

DISCUSSION

Using school catchment areas as geographic units of analysis, the present study hypothesized urban-rural differentials in the social mechanisms leading from structural factors to collective-level student-substance-use rates. But school catchment boundaries do not delimit social exchange, so we furthermore hypothesized that SCAs with high rates of student substance use should cluster together, exhibiting a social diffusion process. Using two different models, we demonstrated this diffusion process by incorporating the spatial lag term of the outcome and all spatial lag terms of the independent variables. Obtaining a significant spatial lag term for the outcome, as we did, should indicate that student substance use in a focal catchment is associated with observed and/or unobserved variables characterizing its neighboring catchments. Observed variables were the 5 structural factors already in the model; unobserved variables might include correlates, such as access to drug-use treatment³². Including in our second model the spatial lag terms of all independent variables helped specify observed structural factors of neighboring catchments that were responsible for rates of student substance use in a focal catchment.

Overall, our results show location matters, shaping the social dynamics responsible for student substance-use rates—although at the same time the results support recent claims in the literature of negligible differences in adolescent substance use in rural versus urban SCAs¹⁰. Our study made clear that social-organization factors arising from school and community helped reduce student substance use in rural and urban catchments; it also observed very limited impact on the part of structural-disadvantage factors. (While it is well documented that, in adult populations, structural disadvantages are associated with elevated crime and deviance, the literature reporting on adolescent samples shows mixed results³³.) In the rural (only) catchments we analyzed, community instability's effects on student substance use were small but significant. Our analysis also clearly showed a differential spatial diffusion process helping explain rural and urban students' differential recent marijuana use.

Greater structural disadvantages (i.e., community instability, alcohol-outlet density) were measured in the urban catchments we studied, but these disadvantages showed no significant

impact on urban students' substance use. (When we looked at the standard deviations of structural-disadvantages measures, we found a large variation associated with alcohol-outlet density in urban SCAs versus rural SCAs, perhaps attributable to the presence of dry counties in Alabama; in them, alcohol-outlet density is of course negligible, while in urban areas it can be notable.) Where a rural SCA demonstrated the disadvantage of instability, however, rates of 30-day alcohol-use and marijuana-use increased significantly among students. Our measure of community instability evaluated percentage of population that had moved house recently, percentage having a college degree, and percentage having a high school diploma. In a rural community that is fairly unstable, then, we may see reflected some educated population allowing their children to engage in risk-taking behavior including alcohol and marijuana use. Rural students' substance use was associated more strongly than urban students' substance use with the educated population's behavioral patterns.

Once we controlled studied catchments' structural factors, we observed strong spatial lag effects helping explain student substance use. For rural and urban SCAs alike, when neighboring catchments' alcohol-use rates increased, a focal catchment's rate also rose (attributed to observed and unobserved variables in each catchment). In addition, when we included spatial lag terms for all of the structural factors, the model pointed to students' prosocial behavior and its encouragement and reward by schools as the most significant protective factor in recent alcohol use. A school's encouragement and reward of its students' prosocial behavior was also associated with less alcohol use by students in neighboring catchments.

We did not find spatial processes to be related to urban-rural differences in student alcohol use. However, we did obtain evidence that some spatial effects explained urban-rural differences in the social mechanisms that underlie students' marijuana use. Specifically, and echoing the finding for alcohol use, strong collective encouragement and rewarding of prosocial behavior in an urban school helped protect against marijuana use not just students at that school, but students at neighboring schools as well. We found no empirical evidence in rural catchments of spatial diffusion of student marijuana use. In urban areas, in contrast, catchments with elevated rates of student marijuana use clustered together.

That we observed no significant spatial lag effect for larger rural catchments (those taking in more square miles) may result from the fact we did not control for the geographic size of the SCAs we studied (whether urban or rural). However, it is also possible that the significant spatial lag effect we did observe for rural catchments when it came to recent alcohol-use rate, pertains not to geographic size but to type of substance; substance, then (and not catchment size), would be essential for explaining spatial patterning of student drug use. In addition, while we found no significant urban-versus-rural differences in the impact of alcohol-outlet density (a spatial process) on recent marijuana use, alcohol-outlet density was observed to be significantly associated with recent marijuana use by urban students but not rural students. This suggests that in urban areas, dense alcohol outlets—a sign of community disadvantage—may be associated with illicit drugs' availability and use, two factors apparently shaping behavior across contiguous communities.

Evidence from our study suggests that structural factors' role in urban-rural differences in student substance use is very limited. On the other hand, our study shows social-organization factors' role in reducing use is vital—whether students come from urban or rural areas. Such results are consistent with social disorganization theory's main themes. They clearly illustrate the importance of collective efforts (in schools and in communities) to promote prosocial behavior, since those efforts do reduce adolescent substance use^{20, 34, 35}.

Our findings about alcohol-outlet density (see Tables 1 and 3) seem to offer support both for social disorganization theory and routine activities theory. These postulate the importance of “population” and “place” to any understanding of adolescent substance use. For instance, a “place” lacking political and financial power is comparatively unable to prohibit alcohol-sales outlets from setting up shop within it^{36, 37}. Dense alcohol outlets are a structural disadvantage. Having densely located alcohol outlets was clearly associated, in our study, with meager social organization generated by school (in our rural SCAs) and community (in our urban SCAs); and with (in rural SCAs) relatively high rates of student marijuana use. Adolescents in our sample, when visiting neighboring communities with densely located alcohol outlets, left behind the guardians who might take an interest in their behavior, and encountered instead peers with attitudes favoring illicit drug use who have access to marijuana and create the opportunities requisite to increased marijuana use³⁸.

Because we found recent use of marijuana and alcohol alike to be strongly associated—in rural and urban areas—with our social-organization factors, we hold that community and school collaboration is important for reducing substance use; this is true even in areas deemed structurally disadvantaged. School teachers, administrators, and staff represent a crucial force that can mobilize students in prosocial activities, protecting students against substance use. Moreover, the students protected may not just be their own, according to our findings, which show that advantages a school (urban or rural) reaps by fostering prosocial behavior benefit students at that school and also at neighboring schools.

We note three limitations on our study. First, generalizing of results beyond the state of Alabama should be cautious, because the sample was strictly limited to Alabama school catchments and students. With 44.6% of its population living outside urban and suburban areas, Alabama is considered distinctively rural. Such limits on the scope of inquiry, however, far from thwarting our specified purposes instead made it possible to manage the analysis of data involving spatial processes and social mechanisms connecting structural factors to student substance use. Furthermore, our significant finding that one school’s encouragement of prosocial activity can help lower student substance use among its own *and* neighboring students calls for additional investigation of this relationship beyond Alabama, to include states not as rural—and countries with school systems not following the American model.

Second, there was a certain arbitrariness in our measure of urbanness here, and it may have increased the variation observed for some structural-disadvantage and social-organization factors in urban SCAs. Our use of school catchments as geographic units of analysis, however, was carefully pursued, with each catchment classified urban or rural based on a clear criterion (percentage of urban population within the catchment). Third, while we measured our structural-disadvantage factors via census data, we were unable to obtain direct measures of the two social-organization factors or of the two recent-use factors. Therefore, we constructed measures for these four factors, aggregating the responses given by the surveyed students⁸. Our employment of disparate measures could have played a role in the weak associations we found between structural-advantage factors and rate of recent use of alcohol as well as marijuana.

The three limitations notwithstanding, our study generated results that imply that substance-use-protective social organization can be consciously created within schools and communities and will help students most if it takes into account their urban or rural location^{9, 39}. Those responsible for making policy and developing interventions also need to weigh the influential dynamics and exchanges among school catchments. Those conducting further research might explore social processes and spatial processes that may underlie the quite similar levels of rural adolescents’ and urban adolescents’ substance use.

Acknowledgments

This study was supported by the NIAAA Grant Number R03AA017165. NIAAA had no role in the study design, collection, analysis or interpretation of the data, writing the manuscript, or the decision to submit the paper for publication. This study used data gathered by the Substance Abuse Services Division of the Alabama Department of Mental Health. The interpretation and reporting of these data are the sole responsibility of the authors, and the views and opinions expressed do not necessarily reflect those of the Alabama Department of Mental Health.

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Table 1
Means, Standard Deviations, and Correlations of All Included Variables for Urban and Rural School Catchments

	Correlations							Urban Catchments			Rural Catchments		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	Mean	S.D.	N	Mean	S.D.	N
Population Disadvantage (1)	1	−0.356**	−0.140*	0.061	−0.156*	−0.020	−0.070	0.711	5.102	213	0.043	5.382	286
Community Instability (2)	−0.395**	1	0.478**	−0.128	−0.150*	0.166*	0.198**	40.392	28.639	213	13.219	13.675	286
Alcohol-Outlet Density (3)	0.153*	0.254**	1	−0.155*	−0.121	0.123	0.157*	1.229	3.698	213	−0.925	0.269	286
Protective Role of School (4)	−0.022	0.077	−0.003	1	0.593**	−0.599**	−0.523**	0.114	0.420	169	0.156	0.480	209
Protective Role of Community (5)	−0.285**	0.112	−0.305**	0.425**	1	−0.531**	−0.495**	0.074	0.301	169	0.170	0.304	209
Adj. 30-Day Alcohol-Use Rate (6)	−0.002	−0.140	−0.045	−0.587**	−0.407**	1	0.802**	0.250	0.127	168	0.264	0.119	209
Adj. 30-Day Marijuana Use Rate (7)	−0.032	−0.149	−0.041	−0.532**	−0.432**	0.872**	1	0.118	0.068	168	0.115	0.059	209

Note: Correlations for urban catchments are located on the left corner below the diagonal; correlations for rural catchments are above the diagonal

Note: T-tests were used to compare mean differences in all included variable between urban and rural catchments; Significant differences are presented in boldface, underlined figures.

*
p < .05

**
p < .01

Table 2
Regression Results on Adjusted 30-Day Alcohol-Use Rate for Urban Catchments (N=163) and Rural Catchments (N=207)

Independent Variables	Urban			Rural		
	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.
Constant	.275	.015**	.312	.016**	.265	.028**
Pop. Disadvantage	-.003	.002	-.003	.003	.000	.001
Instability	.000	.000	.000	.000	.001	.001
Alcohol-Outlet Density	-.002	.002	-.001	.002	-.014	.024
Protective Role of School	-.081	.024**	-.110	.021**	-.075	.020**
Protective Role of Community	-.082	.030**	-.085	.032**	-.092	.027**
Spatial Lag Term						
Wy	.048	.010**		.027	.008**	
WX (Pop. Disadvantage)			-.001	.003	-.002	.003
WX (Instability)			-.001	.001	-.001	.001
WX (Alcohol-Outlet Density)			.000	.004	-.012	.039
WX (Protective Role of School)			-.112	.029**	-.075	.023**
WX (Protective Role of Community)			-.022	.039	.020	.038
R ²	0.481		.486		0.439	.453

Note: Significant differences in coefficients between urban and rural catchments are presented in boldface, underlined figures.

Wy is the spatial lag term of 30-day alcohol-use rate or the weighted average of the 30-day alcohol-use rate for neighboring SCAs.

Wx is the spatial lag term of the independent variable.

*
p < .05

**
p < .01

Table 3
Regression Results on Adjusted 30-Day Marijuana-Use Rate for Urban Catchments (N=163) and Rural Catchments (N=207)

Independent Variables	Urban			Rural		
	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.
Constant	.132	.009**	.148	.009**	.128	.015**
Pop. Disadvantage	-.001	.001	.000	.002	-.001	.001
Instability	.000	.000	.000	.000	.000	.001
Alcohol-Outlet Density	-.002	.001	-.002	.001	.002	.013
Protective Role of School	-.041	.013**	-.046	.012**	-.035	.010**
Protective Role of Community	-.058	.018**	-.063	.018**	-.058	.015**
Spatial Lag Term						
Wy	.019	.006**		.005		.004
WX (Pop. Disadvantage)			-.002	.002		-.003
WX (Instability)			.000	.000		-.001
WX (Alcohol Density)			.005	.002*		.006
WX (Protective School)			-.063	.016**		-.007
WX (Protective Community)			.003	.022		-.010
R2	0.407		.447	0.355		.367

Note: Significant differences in coefficients between urban and rural catchments are presented in boldface, underlined figures.

Wy is the spatial lag term of 30-day marijuana-use rate or the weighted average of the 30-day marijuana-use rate for neighboring SCAs.

Wx is the spatial lag term of the independent variable.

*
p < .05

**
p < .01