Physical, Social, and Perceived Availabilities of Alcohol and Last Month Alcohol Use in Rural and Small Urban Communities

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Abstract

This study seeks to provide a greater understanding of the factors that determine the perceived availability of alcohol and its role in predicting adolescents' alcohol use. Participants were 151,703 7th–12th grade students (50% female) from a sample of 219 rural communities across the United States, with oversampling for predominantly Mexican-American and African-American communities. Multilevel analysis was used to estimate the perceived availability of alcohol as a function of physical and social availability measures and individual and community-level control variables. Physical availability was measured as the number of alcohol outlets in the community and whether beer and wine were sold in non-liquor stores. Social availability measured the availability of alcohol from social or family groups. Last month alcohol use was then estimated as a function of physical, social and perceived availabilities and control variables. Physical availability had little relationship to perceived availability or recent alcohol use while social availability was a strong predictor of both. Perceived availabilities at the individual and community levels were significant in predicting last month alcohol use. The findings suggest that altering both perceived and actual availability of alcohol can potentially have strong effects on the levels of adolescent alcohol use.

Keywords

Rural adolescents; Alcohol use; Alcohol availability; Perceived availability; Physical availability; Social availability

Introduction

Adolescent alcohol use continues to be a serious public health concern that can produce harmful, even life-threatening, consequences in both the short and long-term (National

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Institute on Alcohol Abuse and Alcoholism 2004/2005; National Institute on Drug Abuse 2005). As a result of its prevalence and deleterious consequences, a great deal of money and effort has been placed on preventing and/or limiting alcohol use among young people. These efforts generally follow one of two strategies: reduce the motivation to use or reduce the availability of or access to substances (Harrison et al. 2000). Initiatives focused on reducing motivations to use tend to promote health and personal development among youth, teach refusal skills, modify normative beliefs, and correct misperceptions about peers' use of alcohol. Initiatives focused on reducing the availability of alcohol tend to focus on changing the physical, economic, social, or legal environment in which young people make decisions to use alcohol (Higher Education Center for Alcohol and Other Drug and Violence Prevention 2007). These types of strategies are often referred to as environmental approaches (Wagenaar et al. 2004/2005), and they operate under the premise that youth who have limited access to alcohol will be less likely to use it. For example, implementation of stronger laws to penalize adults who supply alcohol to minors and minimization of alcohol outlets represent strategies designed to reduce access. Generally, policies focused on reducing access to alcohol have depended on laws and regulations that decrease the opportunities for young people to use alcohol.

Physical Availability of Alcohol

The relationship of the availability of alcohol on alcohol consumption has been a topic of research for several decades, especially as it concerns physical availability, measured as the density of alcohol outlets, and the adult use of alcohol. This research has established, for the most part, that the density of alcohol outlets within a neighborhood or a community is positively related to alcohol consumption and alcohol-related outcomes (Gruenewald et al. 1993; Gruenewald and Remer 2006; Scribner et al. 1994). The premise is that a high number of alcohol outlets within a specified environment makes alcohol easier and less costly to obtain in terms of time and money. However, because these studies have used aggregate data (e.g., alcohol consumption at the neighborhood level), one cannot infer either an individual-level effect or a structural effect at the neighborhood level (Scribner et al. 2000).

Studies using individual-level data have found mixed results concerning the relationship between physical availability and alcohol use. For example, Scribner et al. (2000) report findings consistent with studies that find a relationship between alcohol outlet density, alcohol consumption, and drinking norms. However, their findings show that the density of alcohol outlets operates on alcohol-related outcomes at the neighborhood level, not at the individual level, thus suggesting that residents with similar drinking patterns and norms tend to aggregate in neighborhoods predicted by alcohol outlet densities. In a study of over 700 adults, Abbey et al. (1993) found that physical availability was not significantly related to alcohol use, though other types of availability were. On the other hand, in a study of 32 college campuses, Scribner et al. (2008) found that higher densities of on-premise alcohol outlets were strongly related to drinking outcomes, and Treno et al. (2003) found that the number of on- and off-premise establishments licensed to sell alcohol were associated with both drinking and driving and riding with drinking drivers among a sample of California youth. These studies reflect the lack of clarity in the literature regarding the relationship

between physical availability and alcohol use, and the complexity of this issue broadens when social availability is considered.

Social and Subjective Availability of Alcohol

Smart (1980) suggested that, at the individual level, subjective and social factors may mediate and outweigh the relationship between physical availability and alcohol use. To this end, he defined two additional types of availability—social availability ("availability within small social or family groups" (p. 124)) and subjective availability ("individual differences in how accessible people feel that alcohol is to them" (p. 124)). Research has generally supported the importance of social and subjective availabilities. Using structural equation modeling, Abbey et al. (1990) found that for a metropolitan sample of adults, physical distance from an outlet (physical availability) was only indirectly related to alcohol use via its negative relationship to subjective availability. On the other hand, subjective and social availability measures were positively related to alcohol consumption. In a later study, Abbey et al. (1993) found that while subjective and social availability indicators were significantly related to alcohol use, physical availability, as measured by distance from alcohol outlets, was not. Overall, their study did find strong relationships between respondents' alcohol consumption and variables such as friends' alcohol consumption, perceived obligation to drink alcohol at social gatherings, and availability of alcohol at social gatherings. The authors argue that this social availability creates an atmosphere in which drinking is acceptable. In addition, they contend that, based on their results, laws designed to limit alcohol availability are not likely to produce reductions in alcohol consumption, unless these limits are severe.

Adolescent Alcohol Use and Availability

For adolescents, physical availability may have even less of an effect on alcohol consumption than for adults. A major portion of the costs of drinking for this group lie in factors related to the illegal nature of the activity—the costs of obtaining alcohol and the cost if one is caught and punished. Consistent with this premise, in a study of Oregon youth, Dent et al. (2005) found that the perceived rate of illegal merchant sales in the communities, as reported by the respondents, was related to all alcohol-use outcomes. Moreover, communities with higher mean perceived minor-in-possession law enforcement had somewhat lower rates of alcohol use and binge drinking. Thus, in communities with lower perceived enforcement, and thus lower costs of getting caught and punished, alcohol use was higher than in communities with higher costs of getting caught.

Given the costs to adolescents of obtaining alcohol directly from commercial sources, empirical evidence suggests that most adolescents obtain alcohol from social or familial sources (Dent et al. 2005; Harrison et al. 2000). Therefore, it is paramount to consider physical, social and perceived measures of availability when examining the relationship between access to alcohol and adolescent drinking behavior. One recent study examined the interrelationships between these different types of availability and alcohol use for a nationally representative sample of 8th and 9th grade adolescents in Switzerland (Kuntsche et al. 2008). In particular, these authors used a multilevel approach to investigate first, whether perceived availability of alcohol was related to both characteristics of the

adolescents' social environment and to physical availability as measured by the per capita outlet density in a community and second, whether adolescents' alcohol use was related to perceived availability, social environment characteristics, and outlet density. The results indicated that perceived availability is associated with having peers and siblings who drink, going out without parental knowledge of whereabouts, drinking in public settings, and the density of on-premises, but not off-premises, alcohol outlets. Alcohol use was found to increase with increased perceived availability. Similarly, volume drinking increased with higher community-level perceived availability and the density of on-premises, but not off-premises, outlets. However, whether these results are generalizable to US youth is open to question given the significant differences between Swiss and US laws and norms concerning adolescent alcohol use.

Ethnicity and Perceived Availability

Rates of alcohol use vary across ethnic/racial groups of adolescents (Delva et al. 2005; Wallace et al. 2003; Swaim and Stanley in press), with African-American youth, in general, tending to use alcohol less frequently than other racial/ethnic adolescent groups. However, whether African-American youth also perceive less availability of alcohol is not clear. On the one hand, disparities in alcohol environments by ethnicity have been noted in the literature. For example, Truong and Sturm (2009) found greater numbers of alcohol licenses around residences of minority and lower-income residents while Scribner et al. (2008) found off-sale alcohol outlet density positively associated with the percentage of African-American residents. Yet, as noted by Scribner et al. (2008), levels of alcohol consumption are typically less and drinking norms more conservative in African-American communities. In a study comparing the alcohol use of white, Mexican-American, and African-American youth, Swaim and Stanley (in press) found that African-American students residing in African-American communities were the least likely to try alcohol or get drunk. This suggests that there may be a community effect of ethnicity beyond that of individual ethnicity. However, whether that is the case for perceived availability of alcohol is not known.

The Present Study

Following Kuntsche et al. (2008), but using a large US national sample of rural and small urban communities, this study seeks to provide a greater understanding of the factors that are related to the *perceived availability* of alcohol and its role in predicting adolescent alcohol use. To better understand the relationship between social versus physical availability and adolescent alcohol use, we first use a multilevel framework to model the perceived availability of alcohol as a function of physical and social availability. Physical availability is measured at the community level while social availability is measured at the individual level. Based on the research noted above, we expect that perceived availability will be positively related to social availability (H1) and to physical availability (H2). Because the data used for this study include communities with large numbers of African-American youth and communities with large numbers of Mexican-American youth, we can also examine these relationships for predominantly African-American and Mexican-American communities. We expect that African-Americans will perceive less availability of alcohol, especially those living in African-American communities (H3).

Alcohol use is then modeled as a function of social, physical, and perceived availabilities. Perceived availability is included as both an individual level predictor (i.e., a student's perceived availability) as well as a community-level predictor (the average perceived availability of all surveyed students in the community). We expect that individual perceived availability will be positively related to alcohol use, even after controlling for peer, family, and other influences (H4). In addition, we expect that perceived availability will have a positive contextual (community-level) association with alcohol use beyond the individual-level relationship (H5). This community-level aggregate of perceived availability may capture a broader assessment of the true availability of alcohol to minors than is provided by a single adolescent. In other words, it may represent a community's norms toward alcohol use. Thus, it can answer the question—Given two students who report similar individual perceived availability but live in two different communities, is the student who lives in the community where students in general report higher perceived availability more likely to use alcohol?

While the analysis reported here contributes to the current research by taking a multilevel approach to these critical questions, this study also offers valuable insight into a population that is largely understudied. Rural youth represent one-quarter of American adolescents, yet they have been largely neglected in research investigations (Preston and Mansfield 1990). A report from the National Center on Addiction and Substance Abuse (CASA) at Columbia University (2000) suggested that rural adolescents are at an equal, and possibly increased risk, for alcohol abuse than their non-rural peers. They note, in fact, that a higher percentage of rural 8th, 10th, and 12th grade students reported past month use of alcohol than students in non-rural areas. Despite this evidence, there has been an insufficient amount of research conducted to better understand the causes and correlates of alcohol use among rural youth. The effect of physical availability on alcohol use may be different for youth living in rural versus urban communities. In many rural locations, alcohol outlets may be more difficult to reach due to long distances, especially for youth who do not drive, making access to alcohol even more costly to rural youth than to urban youth. On the other hand, if community norms are more favorable to alcohol use in rural areas, perceived availability may be significantly higher in rural areas than in urban areas. Including a variable that measures level of rurality can help determine whether the relationship between availability and alcohol use is different for youth living in rural versus urban communities.

Method

Data

Student-level data came from a study of alcohol and drug use in rural and small urban predominantly white, Mexican-American, and African-American communities within the contiguous US. The original sample of 272 communities was drawn from a strategically developed sampling frame designed to be representative by rurality level and geographic region throughout the contiguous US. For example, predominantly white communities (over 60% white, non-Hispanic) within each of the rurality categories were proportionately drawn to their representation in each of the four regions and each state within those regions, where possible. For detailed information on sampling of communities, survey content, and survey

administration, see Stanley et al. (2008) and Edwards et al. (2007). For this analysis, a subsample of 219 communities was chosen. These communities have populations between 120 and 50,000, are not adjacent to a metro area, and have only one zip code area.

Within each community, surveys were administered at the public high school and the public feeder junior-high/middle school(s). For analysis, the sample was divided into 7th–9th grade students and 10th–12th grade students because the opportunities and environments as related to alcohol availability change significantly as students move into 10th grade (e.g., they begin driving and working outside the home). The final sample consisted of 83,454 students in grades 7–9 and 68,249 students in grades 10–12. Approximately 50% of students were female, 62.7% were White, 13.4% were African-American and 14.2% were Mexican-American.

Students were given the Community Drug and Alcohol Survey (CDAS), a variation of the American Drug and Alcohol Survey™ (Oetting et al. 1985; Rocky Mountain Behavior Institute, Inc. n.d.) which has been in use since the mid-1980s. Its measures have been through rigorous reliability and validity analysis, and it is one of the instruments listed in SAMHSA's Measures and Instruments Resource guide (2007). Surveys were conducted between the years 1996 and 2000 with passive parental consent and procedures that ensured complete confidentiality. Surveyed schools with less than 70% of enrolled students taking the survey, schools where honesty questions suggested evidence of poor administration, or schools where there were large numbers of invalid surveys were replaced.

Measures

Measures calculated from several items were computed as the sum of scores divided by the number of items. Table 1 provides the means and standard deviations of the variables used in this study by community ethnicity. Where appropriate, Cronbach's alphas are given below, with 7th–9th grades appearing first in the parentheses.

Alcohol Use—Students were asked how many times in the last month they had alcohol to drink. Responses were categorical (0, 1–2, 3–9, 10–19, 20 or more).

Perceived Availability of Alcohol—To measure perceived alcohol availability, respondents were asked to rate the ease with which they could obtain alcohol. Responses ranged from 1 to 5 with 1 being probably impossible and 5 being very easy. A "contextual" measure of perceived alcohol availability was computed as the mean student perceived availability rating in the community for that substance (Raudenbush and Bryk 2002). It was calculated separately for 7th–9th graders and 10th–12th graders. Over 95% of communities had 50 or more students contributing to this aggregate measure, with a mean number of students of 381 for 7th–9th grades and 312 for 10th–12th grades.

Social Availability—Moore et al. (2007) define social availability as the degree of normative support for or against drinking within one's social environments. They define both objective social availability—the actual drinking of family, friends, and social referents—and subjective social availability—individual's perceptions of drinking norms in a given environment. For this study, we use subjective measures that represent a respondent's

perceptions of normative support in four domains—peers, parents, school, and community. With respect to peers, students were asked how many of their friends get drunk, with 1 being none and 4 being all of them. Because the survey did not include items measuring parent drinking, parental attitudes toward alcohol use by the youth was used as a measure of subjective social availability in the family environment. It was measured with two items —my parents don't care if I drink and my parents don't care if I drink at home, with 1 being very true and 4 being not at all true (7–9: α = .88; 10–12: α = .85). The school and community variables were measured with one item each—how much trouble would you get into if caught drinking alcohol at school (1 = none; 4 = a lot) and what are the chances you will be caught drinking alcohol by a law enforcement officer (1 = unlikely; 4 = very likely).

Physical Availability—Counts of NAICS industries 445310 (liquor stores, package) and 722410 (Drinking Places (Alcoholic Beverages)) by zip code were obtained from the Economic Census for the year the survey was given to measure off-premise and on-premise outlets. Using 2000 Census population figures, liquor outlets per 1,000 habitants were calculated. The off-premise and on-premise measures were calculated separately initially, but in the final analysis were combined into one measure. In addition, because the Economic Census data does not include all licensees (e.g., grocery stores), we also include a variable measuring whether the community allowed beer and/or wine to be sold in grocery and other non-liquor stores in the year surveyed.

Demographic Variables—Control variables included at the individual level of the analysis are gender (coded as 1 for females and 0 for males), grade (centered at grade 7 for grades 7–9 and grade 10 for grades 10–12), and race/ethnicity (dummy coded to compare white and other students to African-American and Mexican-American students). At the community level, ethnic composition of a community compares predominantly white communities (over 60% Anglo Americans) to African-American (over 40% African Americans) and Mexican-American communities (over 40% Mexican Americans). Communities were also classified into three levels of rurality: remote, medium rural, and small urban. A remote community has a population less than 2,500 and is located more than 2 h driving time from a metropolitan area. A medium rural community either has a population between 2,500 and 20,000 or a population less than 2,500 but is located less than 2 h driving time from a metropolitan area. A small urban community has a population between 20,000 and 50,000.

Analysis

Multilevel Model (MLM) Analysis—For each grade group, perceived availability of alcohol was estimated using a multilevel analysis as a function, first, of physical availability and the individual and community-level control variables and, second, as a function of these variables and the social availability variables. Then a multilevel model for last month alcohol use was estimated as a function of perceived availability at the individual and community levels, social availability, and the individual and community-level control variables. Interaction terms between physical availability measures and community ethnicity variables were explicitly included to estimate any differential relationships between physical

availability and ethnic type of community. Random effects and interaction terms between individual-level and community-level variables were tested using likelihood ratio tests.

Variables that are not categorical are grand-mean centered. The dependent variables for both models above are specified as ordinal and are analyzed using appropriate MLM techniques for ordinal variables using HLM 6.

Missing Data Procedures—The amount of missing data ranged from 0 to 20.6% for 7th–9th graders and 0 to 8% for 10th–12th graders. Approximately 70% of observations for 7th–9th graders and 80% of observations for 10th–12th graders had no missing data. To account for missing data, multiple imputation (Shafer and Graham 2002) was completed using ICE in Stata software, Version 10.0 (Royston 2004, 2005, 2007). ICE imputes by chained equations, and its major strength is that there is no multivariate joint distribution assumption, thus allowing different types of variables to be imputed together. Simulation studies have shown that in practice it performs well (Royston 2005). In total, ten imputed data sets were created and analyzed, and the parameter estimates were then combined using the procedures outlined by (Rubin 1987).

Results

Means and standard deviations of all measures are presented in Table 1 for 7th–9th graders and for 10th–12th graders. For 7th–9th graders, mean perceived alcohol availability is 3.67 for African-American communities (where 3 is hard and 4 is fairly easy), 3.74 for Mexican-American communities and 3.93 for white communities. As expected, perceived availability of alcohol is higher for students in grades 10–12, ranging from 4.32 for African-American communities to 4.52 for white communities. Mean per capita liquor outlets (on and off-premise outlets per 1,000 population) vary significantly by community ethnicity. The mean number of liquor outlets is lowest for Mexican-American communities at a rate of .22 per 1,000 population and highest for African-American communities at .58 per 1,000 population in the 7th–9th grade sample.

Table 2 presents the multilevel results for perceived availability of alcohol, with columns (1) and (2) giving estimates for 7th–9th graders and columns (3) and (4) giving analogous estimates for 10th–12th graders. The first column for each grade group shows the results when only the control and physical availability variables are included while the second column shows the results when measures of social availability are added to the model.

Perceived Availability and Physical and Social Availabilities

Two models were tested, one that excluded the social availability measures and a second that added the social availability measures as additional individual-level predictors. For both grade groups, physical availability (measured as per capita liquor outlets and as beer and wine sold in grocery/other stores) shows no association with perceived availability in either model (without and with the social availability variables).

On the other hand, several of the social availability variables have strong associations with perceived availability. For both grade groups, parental attitude toward alcohol use and

the chances a youth is caught drinking by police are both negatively related to perceived availability. For 7th–9th graders, the odds ratios are .74 and .84, respectively, while for 10th–12th graders, they are similar at .75 and .77, respectively, indicating that when youth perceive more parental sanctions against alcohol use and when they perceive that there is a higher probability of getting caught by the police, they tend to perceive that alcohol is less available in the community. The trouble a youth would get into if caught drinking at school was not significantly related to perceived availability for either grade group.

Perceived Availability and Ethnicity

For 7th–9th graders, when the social availability variables are not included in the model, African-American students perceive less availability, with relative odds of .82, compared to a similar white student. An African-American student living in an African-American community perceives even less availability, all else equal, with an odds ratio of .73 (.82*.89). Once the social availability measures are included in the model, the odds of an African-American student perceiving a higher level of availability is about .85 that of an otherwise similar white student while the odds of perceiving a higher level of availability for a student living in an African-American community are about .86 that of an otherwise similar student living in a white community.

Interestingly for 10th–12th graders, when the social availability variables are not included in the model, an African-American student living in an African-American community has odds of perceiving a higher level of availability about .73 times that of a similar white student living in a white community. However, once the social availability measures are included in the model, there are no significant associations between ethnicity and perceived availability.

Although no hypotheses were proposed for Mexican-American ethnicity, there were some significant results with respect to these variables. In the model without social availability variables, 7th–9th grade Mexican-American students perceive higher availability than their white counterparts if they live in white communities, but lower availability if they live in a Mexican-American community. Once the social availability measures are included, 7th–9th grade students (of any ethnicity) living in Mexican-American communities perceive less availability than those living in white communities, especially if they are Mexican-American students.

Other Results

Rurality shows little association with perceived availability. In the models with no social availability variables, 7th–9th grade students living in medium rural communities had a slightly higher level of perceived availability than their otherwise similar counterparts living in remote or small urban communities (odds ratio of 1.10) while 10th–12th grade students living in remote communities had a slightly higher level of perceived availability than their counterparts living in medium rural and small urban communities (odds ratio of 1.12).

Last Month Alcohol Use and Perceived Availability

Table 3 presents the multilevel results for last month alcohol use, with the first column giving estimates for 7th–9th graders and the second column giving analogous estimates

for 10th–12th graders. As hypothesized, for both grade groups, higher individual perceived availability increases the likelihood of greater last month alcohol use (relative odds of 1.43 for 7th–9th grades and 1.32 for 10th–12th grades), even after controlling for peer, family and other influences. Thus, for example, a 10th grade student who reports a value of perceived availability one unit above the mean will have odds of a higher level of last month alcohol use of 1.32 times an otherwise similar student with mean level of perceived availability.

Community-level Perceived Availability and Alcohol Use

For both grade groups, higher community perceived availability is associated with higher last month alcohol use (relative odds of 1.22 for 7th–9th graders and 1.52 for 10th–12th graders).

Other Results

The physical availability variables at level 2 showed significant relationships with last month alcohol use in interaction with the community ethnicity variables. In particular, an increase in the number of per capita liquor outlets in ethnic communities is associated with a decrease in last month alcohol use by adolescents in those communities compared with otherwise similar youth in white communities. In addition, adolescents in Mexican-American communities where beer/wine are sold in non-liquor stores have less last month alcohol use (odds ratio of .80 for both grade groups), compared to similar youth in white communities that sell beer/wine in non-liquor stores.

The social availability variables related to peer drunkenness and parental attitudes toward drinking also have strong relationships to last month alcohol use (relative odds of 2.46 and .53, respectively, for 7th–9th grades and 2.49 and .56 for 10th–12th grades). On the other hand, the social availability variables related to school and community have odds ratios very close to 1 for both grade groups, indicating that these variables have little direct relationship to last month alcohol use.

Discussion

Past research has found a positive relationship between physical availability (i.e., the density of alcohol outlets) and alcohol use; however, much of this research has used aggregate-level data and adult populations. While such findings make sense for adults, this relationship may not be as strong among adolescent populations for whom availability is less likely to be related to alcohol outlets. Researchers such as Smart (1980) and Abby et al. (1990) have suggested that physical availability at the individual level, especially for adolescent populations, is probably less important in predicting alcohol use than social and subjective factors related to availability. Using a large, national dataset of adolescents living in rural and small urban communities, this study sought to provide a greater understanding of the relationships between social and physical availabilities and perceived availability of alcohol for adolescents and the role of this perceived availability in predicting alcohol use. Furthermore, we took a multilevel approach, incorporating both individual-level and community-level variables in our analyses. By using such an approach, we sought to provide

a better understanding of both individual and community-level factors related to both an adolescent's perceived availability of alcohol and his or her alcohol use.

Perceived Availability and Physical and Social Availabilities

The initial set of analyses examined the relationships between various measures of social and physical availabilities and perceived availability of alcohol. Interestingly, compared to studies of adult populations, per capita liquor outlets had no significant relationship with perceived availability among either 7th–9th or 10th–12th grade students. This finding is logical given that youth from grades 7 through 12 do not have direct access to alcohol through liquor outlets based on laws that govern purchase of alcohol by minors. Our results differ from Kuntsche et al. (2008) who found that, for Swiss youth, density of on-site premises was positively related to both perceived availability and volume drinking. However, legal statutes in Switzerland permit drinking among youth from ages 16 to 18 (with variations by canton). These legal variations between Switzerland and the US may well explain why the density of on-site premises was found to be significantly related to perceived availability for Swiss youth while we found no significant relationship between per capita liquor outlets and perceived availability for US youth.

Contrasted with the number of drinking outlets are the relationships between perceived enforcement of laws regarding drinking and perceived availability. We found that among both younger and older adolescents, the perceived chances of being caught drinking by the police was associated with lower levels of perceived availability of alcohol. However, the perception of negative consequences if caught drinking at school was unrelated to the perception of alcohol availability. The reasons for this disparity between detection by police versus school officials are not apparent, but could reasonably be expected to relate to the more severe consequences likely to occur with detection by law enforcement.

As expected, other social influences were also significantly related to perceived availability. Among both 7th–9th and 10th–12th grade students, parents' attitudes toward drinking were negatively related to perceived availability. This is consistent with research that finds that parents who view adolescent drinking positively are more likely to have alcohol easily available to their children in the home (Komro et al. 2007). Additionally, the more peers students had who got drunk, the greater the perceived availability of alcohol. Adolescents are more likely to perceive direct access to alcohol if their peers are drinking (Kuntsche et al. 2008). These findings suggest that the social environment of adolescents is a potent predictor of the perceived accessibility of alcohol.

Ethnicity was also found to be significantly related to perceived availability. Among younger students, African-American students were less likely to view alcohol as easily accessible. However, for 10th–12th grade students, once social availability was controlled, there were no differences in perceived availability by ethnicity. This suggests that future research on availability by ethnic group should include measures of social availability. Failure to do so may lead to the drawing of conclusions for ethnic-based differences that are more accurately due to differences in social availability.

The last set of analyses examined the relationships between last month alcohol use and individual- and community-level perceived availability, in addition to the social and physical availability measures. Physical availability, as measured by per capita liquor outlets, was significantly, but weakly related to last month use among younger white students, and unrelated among older students. However, for Mexican-American communities, a negative relationship between per capita liquor outlets and last month alcohol use was found. This finding is not intuitive, and we are reluctant to interpret it given the lower level of variance of per capita liquor outlets in Mexican-American communities compared to the other groups.

While the majority of studies examining alcohol outlet density and alcohol use have been conducted with adult populations (Abbey et al. 1993; Gruenewald et al. 1996; Treno et al. 2001), less research has been conducted among adolescents. This is understandable given that adults have more access to alcohol than do adolescents. But while we found little relationship between density of outlets and where beer and wine can be sold and both perceived availability and alcohol use, more investigation of this question of minors is warranted.

Social availability measures were found to be strongly related to alcohol use in the last month. While peer drunkenness increased the risk for last month alcohol use substantially, family attitudes against drinking increased protection against adolescent drinking. Because this study made use of secondary data, the peer and family measures used may be measuring both supply-side (e.g., access) and demand-side influences (e.g., motivation to use, social norms). The strong relationship between the peer and family measures and perceived availability lends evidence that they are measuring, at least in part, access or availability. At the same time, when the social and perceived availability measures are all included in the model estimating last month alcohol use, both the social availability and perceived availability measures are strong predictors of last month alcohol use. If, indeed, the perceived availability variable is controlling for supply side influences in the alcohol use model, the coefficients on the family and peer variables would then reflect demand side relationships. The findings are consistent with a large body of literature investigating the role of these social influences on adolescent alcohol use (Henry et al. 2005; Marshal and Chassin 2000; Windle 2000). This then suggests that, given the relationships estimated in Tables 2 and 3, demand-side relationships are likely to outweigh supply-side relationships in last month alcohol use.

Finally, a contextual relationship between perceived availability and last month alcohol use was found for both grade groups. Thus, the perceived availability of alcohol aggregated across individuals in a community has a positive relationship to an individual's alcohol use, even after controlling for the perceived availability of alcohol to that individual. In this case, for two students who report similar perceived availability but live in two different communities, the student who lives in the community where students, in general, report higher perceived availability also report higher last month alcohol use. A contextual "effect" of this nature speaks to how the community level social context (i.e., the normative perception of alcohol availability in the community) might influence an adolescent's use of alcohol in a manner that is not simply reducible to individual perceptions. It would appear

that this aggregated mean of perceived availability is reliably differentiating communities based on the ease of alcohol access by youth in that community and that this normative perception has a unique relationship to an individual's recent use of alcohol. This is an important finding in that a "climate" of easy access to alcohol relates to an adolescent's own alcohol use, regardless of whether or not he/she perceives that alcohol is easy to obtain.

Limitations

Several limitations must be noted before drawing implications. First, because this study utilized a secondary data source, it is limited in the availability of measures. For example, because the original study was not designed to expressly examine availability issues, the social availability measures for the school and community environments were each one-item measures and were approximations to the conceptual definitions of those availabilities. In addition, more objective measures of social availability, such as actual school alcohol policies in force at the time of the survey, were not available. Similarly, the two measures of physical availability represent only two dimensions of physical availability of alcohol. For example, per capita liquor stores and bars does not include all liquor licenses in the community. We attempted to obtain retail license data (on and off premise) for the years the communities were surveyed; unfortunately, we found that for many states, these data are no longer available or the data are available only by county. Including a measure of whether the community allowed beer and wine to be sold in grocery and other non-liquor stores gives another dimension of physical availability, in that it measures whether alcohol is available in outlets commonly frequented by youth (e.g., grocery stores). These variables, though imperfect as availability measures, do represent two important dimensions of physical availability.

Overall, given these measurement limitations, it is important to conduct more comprehensive and targeted research studies in the future to further assess these types of questions. Laws related to alcohol access can differ dramatically state to state and within state. For example, consuming alcohol under the age of 21 is legal in some states if a youth's parents are present and consenting. Future research that includes other measures of alcohol access, such as differences in laws and penalties for breaking such laws, is imperative.

Concerning the contextual effect of perceived availability, caution must be used in interpreting this effect (Hauser 1970; Harker and Tymms 2004). While contextual effects may be real, they can also be a phantom effect due to poorly measured individual variables and/or inadequately specified models (Hauser 1970; Harker and Tymms 2004). Thus, further evidence of contextual effects should be obtained before making strong conclusions.

Finally, because the sample is cross-sectional in nature, we cannot infer causality in the significant relationships found. In this article, we argue that perceived availability is likely to influence alcohol use. However, it is also likely that students who use alcohol perceive more availability. It is doubtful that just one of these situations explains the relationship; rather it is most likely that perceived availability and alcohol consumption are involved in a mutually reinforcing feedback loop (Abbey et al. 1990). Likewise, as with much research in substance use, there are other issues of endogeneity. For example, genetics may be an underlying factor both in parental attitudes toward drinking and a youth's alcohol use, and those who drink

may choose to surround themselves with friends who drink. In a test of endogeneity, Norton et al. (1998) found that controlling for the endogeneity of peer substance use to reduce bias was not worth the reduction in mean squared error, and they suggested that peer influence is empirically more important than peer selection for their sample of adolescents. However, this does not diminish the issue of endogeneity that is likely to be present in these data. Although an instrumental variables approach if often used to deal with this issue, use of a multilevel modeling framework precludes its use here. We suggest that future research use a propensity score approach to better address causality.

Even given these limitations, the results reported here are the first in the US that examine the multilevel predictors of perceived availability and alcohol use among a large sample of youth living in rural and small urban communities. The results corroborated other findings from adult and adolescent populations that social availabilities have strong relationships to perceived availability and that perceived availability is related to alcohol use, even after controlling for other demand-side factors. In addition, the relationship found between the contextual measure of perceived availability and last month alcohol use points to the need for further research into the influence of community climate on the various aspects of adolescent perceptions of alcohol availability. The significance of this area of research should not be underestimated. Both perceived and actual availability of alcohol are variables that can be altered and can potentially have strong and direct effects on levels of adolescents' use.

Acknowledgments

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Table 1

Means and standard deviations by community ethnicity

| | Community ethnicity | | | | | |
| | White | | African-American | | Mexican-American | |
	Mean	SD	Mean	SD	Mean	SD
7th–9th grades						
Individual-level variables						
Perceived alcohol availability	3.93	1.37	3.67	1.60	3.74	1.52
African-American student	.06	.24	.65	.48	.01	.10
Mexican-American student	.12	.33	.01	.11	.75	.43
Female	.50	.50	.50	.50	.51	.50
Grade (grade 7 = 0)	1.01	.81	.98	.82	.98	.82
Parents care about drinking	3.74	.63	3.76	.67	3.73	.70
Peers get drunk	2.02	.95	1.90	.96	2.07	.99
Trouble if caught drinking at school	3.71	.69	3.44	1.01	3.48	.99
Chances caught drinking by police	2.35	.92	2.28	1.10	2.41	1.00
Community-level variables						
Remote	.13	.14	.21	.41	.11	.31
Medium rural	.29	.46	.32	.47	.23	.42
Small urban	.58	.49	.47	.50	.66	.47
Community perceived availability	3.93	.19	3.67	.25	3.74	.23
Per capita liquor outlets (per 1,000 pop.)	.40	.39	.58	.76	.22	.28
10th–12th grades						
Individual-level variables						
Perceived alcohol availability	4.52	.89	4.32	1.19	4.40	1.08
African-American student	.06	.24	.64	.48	.01	.09
Mexican-American student	.09	.29	.01	.09	.72	.47
Female	.51	.50	.53	.50	.49	.50
Grade	.90	.81	.93	.81	.88	.91
Parents care about drinking	3.53	.80	3.70	.77	3.62	.75
Peers get drunk	2.56	.90	2.31	.98	2.60	.94

| | Community ethnicity | | | | | |
| | White | | African–American | | Mexican–American | |
	Mean	SD	Mean	SD	Mean	SD
Trouble if caught drinking at school	3.65	.67	3.48	.90	3.58	.82
Chances caught drinking by police	2.41	.83	2.29	.99	2.45	.90
Community-level variables						
Remote	.13	.34	.21	.41	.13	.34
Medium rural	.30	.46	.33	.47	.23	.42
Small urban	.56	.50	.46	.49	.64	.48
Community perceived availability	4.52	.09	4.32	.18	4.40	.20
Per capita liquor outlets	.39	.39	.43	.80	.22	.29

Table 2

Estimated odds ratios for perceived availability, 7th–9th grades and 10th–12th grades

	7th–9th grades		10th–2th grades	
Intercept	.52[**]	.66[**]	1.76[**]	1.69[**]
Remote	1.05	.95	1.12[*]	1.05
Medium rural	1.10[*]	1.02	1.04	1.01
African-American Comm (AAC)	.94	.86[**]	.93[**]	.92
Mexican-American Comm (MAC)	.95	.78[**]	.99	1.00
Per capita liquor outlets	1.03	1.01	1.00	.98
Beer/wine in grocery/other stores	1.05	1.04	.98	1.04
AAC × per capita liquor outlets	.94	.95	1.04	1.03
MAC × per capita liquor outlets	1.03	1.12	.91	1.01
MAC × beer/wine in stores[b]	1.04	1.21	.98	.98
African-American student	.82[**]	.85[**]	.92	1.09
African-American Comm	.89[*]	1.04	.79[*]	.94
Mexican-American student	1.14[**]	.93[a]	1.00	.97
Mexican-American Comm	.79[**]	.88[*]	.88	.94
Female	.96[**]	.97	1.03	1.13[*]
Grade	1.66[**]	1.32[**]	1.27[**]	1.22[*]
Parents care about drinking		.74[**]		.75[**]
Peers get drunk		2.21[**]		1.96[**]
Trouble if caught drinking at school		1.02		1.01
Chances caught drinking by police		.84[**]		.77[**]
Threshold 2 (δ_2)	3.04[**]	3.46[**]	4.88[**]	5.44[**]
Threshold 3 (δ_3)	5.34[**]	6.44[**]	8.98[**]	10.39[**]
Threshold 4 (δ_4)	7.85[**]	9.74[**]	12.64[**]	14.86[**]

[**] $\rho < .01$

[*] $\rho < .05$

[a] $\rho < .10$

[b] AAC × beer/wine in store not included due to perfect collinearity

Table 3

Estimated odds ratios for last month alcohol use, 7th–9th grades and 10th–12th grades

	7th–9th grades	10th–12th grades
Intercept	.01[**]	.03[**]
Remote	.89[**]	.99
Medium rural	.95[a]	.95
African-American Comm (AAC)	1.11[*]	1.15[*]
Mexican-American Comm (MAC)	1.34[**]	1.29[**]
Per capita liquor outlets	1.03[**]	1.03
Beer/wine in grocery/other stores	.96	.91[a]
AAC × per capita liquor outlets	.90[*]	.97
MAC × per capita liquor outlets	.83[**]	.74[**]
MAC × beer/wine in stores[b]	.80[*]	.80[*]
Community perceived availability	1.22[**]	1.52[**]
African-American student	.94	.86[**]
African-American Comm	1.10	.98
Mexican-American student	1.14[**]	1.06
Mexican-American Comm	.99	.89
Female	.81[**]	.62[**]
Grade	1.12	1.06[**]
Parents care about drinking	.53[**]	.56[**]
Peers get drunk	2.46[**]	2.49[**]
Trouble if caught drinking at school	.94	1.02
Chances caught drinking by police	.96[**]	1.10[**]
Perceived availability	1.43[**]	1.32[**]
Threshold 2 (δ_2)	2.62[**]	2.83[**]
Threshold 3 (δ_3)	12.09[**]	14.42[**]
Threshold 4 (δ_4)	56.28[**]	56.69[**]

[**] $\rho < .01$

[*] $\rho < .05$

[a] $\rho < .10$

[b] AAC × beer/wine in store not included due to perfect collinearity