Alcohol Prevention on College Campuses: The Moderating Effect of the Alcohol Environment on the Effectiveness of Social Norms Marketing Campaigns*

RICHARD A. SCRIBNER, M.D., M.P.H.,† KATHERINE P. THEALL, PH.D., KAREN MASON, M.S.P.H., NEAL SIMONSEN, PH.D., SHARI KESSEL SCHNEIDER, M.S.P.H.,† LAURA GOMBERG TOWVIM, M.S.P.H.,† AND WILLIAM DEJONG, PH.D.†

Epidemiology Section, School of Public Health, Louisiana State University Health Sciences Center, 1615 Poydras Street, Suite 1400, New Orleans, Louisiana 70112

ABSTRACT. Objective: Evaluations of social norms marketing campaigns to reduce college student drinking have produced conflicting results. This study examines whether the effectiveness of such campaigns may be moderated by on-premise alcohol outlet density in the surrounding community. **Method:** Multilevel analyses were conducted of student survey responses (N = 19,838) from 32 U.S. colleges that took part in one of two 4-year randomized, controlled trials completed for the Social Norms Marketing Research Project (SNMRP). In the models, students by year were nested within treatment (n = 16) and control group (n = 16) campuses, which were characterized by the on-premise outlet density in their surrounding community. The moderating effect of outlet density was introduced into the models as an interaction between the treatment effect (i.e., the effect of the social norms marketing campaigns over time) and outlet density. The models were also stratified by campus alcohol outlet density (high vs. low) to examine the effect of the intervention in each type of setting. **Results:** There was a significant interaction between the treatment effect and on-premise alcohol outlet density for one of the drinking outcomes targeted by the SNMRP intervention, the number of drinks when partying, and marginal evidence of interaction effects for two other outcomes, maximum recent consumption and a composite drinking scale. In stratified analyses, an intervention effect was observed for three of the four outcomes among students from campuses with lower on-premise alcohol outlet density, whereas no intervention effect was observed among students from campuses with higher on-premise alcohol outlet density. **Conclusions:** The findings suggest that the campus alcohol environment moderates the effect of social norms marketing interventions. Social norms marketing intervention may be less effective on campuses with higher densities of on-sale alcohol outlets. (*J. Stud. Alcohol Drugs, 72,* 232-239, 2011)

COLLEGE STUDENTS HAVE inflated perceptions of how much alcohol their peers drink (Borsari and Carey, 2001; Perkins and Berkowitz, 1986). Some prevention experts have called for widespread campus-based social norms marketing (SNM) campaigns to provide accurate data on student drinking patterns, arguing that this information would correct misperceptions of drinking norms, lessen normative pressure to drink, and reduce alcohol consumption (Perkins et al., 2005). Research testing the effectiveness of the SNM approach has produced conflicting findings.

In one study, investigators asked a senior administrator at 98 4-year institutions whether the college had conducted a "social norms campaign" but without defining that term. Student surveys conducted at multiple time points did not show drops in alcohol use on SNM campuses compared with control group campuses. Importantly, the investigators did not document whether the reported efforts were of sufficient scope, intensity, or quality to be considered SNM campaigns (Wechsler et al., 2003).

In the Social Norms Marketing Research Project (SNMRP), DeJong and colleagues (2006) conducted a randomized, controlled trial, with 18 4-year colleges randomly assigned either to execute a 3-year SNM campaign or to serve as a control site. Each campaign used campus-based media to deliver school-specific messages about majority drinking norms, which most students misperceived. Cross-sectional mailed surveys conducted at baseline (Year 1) and at posttest (Year 4) revealed that students from SNM institutions had a lower relative risk of alcohol consumption than students from the control group sites. Regression models that took into account the intensity of SNM campaign activity suggested a dose-response relationship.

In a second SNMRP study on 14 additional campuses, however, the investigators did not replicate these findings, with no significant differences in alcohol use observed between the treatment group and control group sites (DeJong et al., 2009). Interestingly, students in the second study reported far greater baseline alcohol consumption than did students in the first study. For example, at baseline students

Received: October 28, 2009. Revision: August 16, 2010.

*This study was supported by National Institute on Alcohol Abuse and Alcoholism (NIAAA) grant R01 AA014679 to the Louisiana State University Health Sciences Center School of Public Health, New Orleans, LA, and by NIAAA and U.S. Department of Education grant R01-AA-12471 to the Education Development Center, Inc., Newton, MA. The views expressed in this article are those of the authors and do not necessarily reflect the official position of the NIAAA or the U.S. Department of Education.

†Correspondence may be sent to Richard A. Scribner at the above address or via email at: rscrib@lsuhsc.edu. Shari Kessel Schneider and Laura Gomberg Towvim are with the Education Development Center, Inc., Newton, MA. William DeJong is with the Department of Social and Behavioral Sciences, Boston University School of Public Health, Boston, MA.

in the first study reached a mean estimated blood alcohol concentration of approximately .08% during their time of recent maximum consumption, whereas the figure for students in the replication study was greater than .13%.

Research has demonstrated a strong population-level association between alcohol outlet density and drinking levels (Scribner et al., 2008; Weitzman et al., 2003). Hence, one explanation for the replication failure is that a greater number of colleges in the second study might have been located in communities with a relatively high alcohol outlet density. Having more outlets promotes easier access to alcohol (Scribner et al., 2008; Weitzman et al., 2003), which in itself might render an SNM campaign far less effective. Beyond that, the very presence of several outlets, coupled with their frequent advertising, conveys a normative message to students that runs counter to the campaign's message, potentially undermining its effectiveness. Moreover, if nearby clusters of bars, taverns, and restaurants are salient drinking locations, the drinking styles observed there may exaggerate perceptions and therefore misperceptions of student drinking that the SNM campaigns are designed to overcome.

To investigate this possibility, the current study determined the density of on-premise alcohol outlets in the communities near the 32 institutions that participated in the SNMRP studies and then tested whether alcohol outlet density moderated the effectiveness of the SNM campaigns they conducted.

Method

The current study was organized as an exploratory study using data from the SNMRP. Data derived from campus surveys were enhanced by including contextual data on the campus alcohol environment and other community characteristics. The analyses were designed to test the possibility that the equivocal effects noted for the SNMRP intervention could be attributed to an effect modification caused by the campus alcohol environment.

Social norms marketing campaigns

The SNMRP was composed of two randomized, controlled trials. Data from these two studies were pooled for the present analysis.

The methods for these studies are reported in detail elsewhere (DeJong et al., 2006, 2009). The first study, with 18 participating colleges, was conducted between 2000 and 2003, and the second study, with 14 participating colleges, ran between 2001 and 2004. Across the two studies, the participating institutions represented all four U.S. census regions (24.5% Northeast, 26.4% South, 32.7% Midwest, and 16.5% West); 58.1% were public institutions, and 41.9% were private. The institutional review boards at the Education Development Center, Inc., and all 32 institutions approved the study procedure.

For each study, qualified institutions were assigned to pairs based on the best overall matches, taking into account several institutional and student body characteristics. Priority was given to student demographic variables, which are known to be predictive of heavy episodic drinking (Wechsler et al., 2002b). One institution from each pair was randomly assigned to be a treatment group site. Therefore, across the two studies, there were 16 treatment group sites and 16 control group sites.

None of the participating institutions had conducted a previous SNM campaign. Administrators at the control group sites signed an agreement to refrain from issuing SNM messages during the study period. Newspaper content analyses, activity reports, and annual key informant interviews confirmed that the control group institutions did not undertake any substantial SNM campaign efforts.

The treatment group institutions ran SNM campaigns for three academic years. Each institution's campaign adhered to the following rules: (a) The core message reported a normative behavior for all undergraduates that corrected a widespread misperception; (b) all SNM materials included the core message, the campaign logo ("Just the Facts"), a brief description of the student survey that provided the data, and the survey definition of a "drink"; (c) the marketing plan employed credible, far-reaching, and cost-effective campus media venues (e.g., posters, newspaper ads, e-mails, presentations); and (d) all messages, materials, and delivery channels were pilot tested and then approved by the project research staff based at the Education Development Center. The investigators took several steps to ensure program fidelity, including conducting in-person training events, distributing a detailed guidebook on campaign development, and using a rigorous checkpoint schedule to ensure that all messages and materials met the program's specific criteria for a well-conducted SNM campaign (DeJong et al., 2006, 2009).

Core messages were based on one of two questions asked in the baseline student surveys: (a) "What is the number of drinks you consume in a week?" and (b) "When you party, how many drinks do you usually have?" Each SNM message followed this format: "[Percentage/proportion] of [Institution Name] students [have/drink] [drinking level] [when they party/per week]." Example: "67% of XYZ University students have 4 or fewer drinks when they party." Twelve of the 16 institutions developed a core message based on the "party" question; specified drinking levels were zero to two drinks ($n = 1$), zero to three drinks ($n = 2$), zero to four drinks ($n = 6$), zero to five drinks ($n = 2$, with one institution using the phrase "when they go out" instead of "when they party"), and zero to six drinks ($n = 1$). Four institutions used a core message based on the "drinks per week" question; specified drinking levels were zero to three drinks ($n = 1$) and zero to four drinks ($n = 3$).

Student-level data collection

Students at SNMRP campuses completed the Survey of College Alcohol Norms and Behavior (DeJong et al., 2006, 2009) annually during the spring semester for 4 years, from 2000 to 2003 in the first study and from 2001 to 2004 in the second study. For each administration, a random sample of 300 students per campus, stratified by class year, received the survey by mail.

The overall response rate across all 32 campuses and across all 4 survey years was 53.1%. The overall response rate for the intervention campuses was 51.3%, with a range from 41.0% to 62.5% across sites. The overall response rate for the control campuses was 54.3%, with a range from 45.4% to 63.3% across sites. These response rates are comparable to those of other recent national studies, such as the College Alcohol Study (Wechsler et al., 2002b), which had a response rate of 52% in its most recent survey in 2001. The final sample size was 19,838 students for all campuses and years. The analyses reported here were limited to students who had nonmissing information on the outcome under consideration, which results in an analytic sample size as low as 19,540 (i.e., for maximum recent consumption).

Student-level measures

Outcome measures. Four outcome measures focused on alcohol use and were targets of the intervention: (a) drinks per week: "What is the average number of drinks you consume in a week?" Throughout the Survey of College Alcohol Norms and Behavior, a *drink* was defined as "a bottle of beer (12 oz.), a glass of wine (4 oz.), a wine cooler (12 oz.), or a shot of liquor (1 oz.) served straight or in a mixed drink"; (b) drinks when students party: "When you party, how many drinks do you usually have?"; (c) recent maximum consumption: "Think back over the last two weeks. What was the greatest number of drinks you consumed at one sitting?"; and (d) a *composite drinking scale* calculated by converting each of the measures to a standardized score (*z* score) and then taking their sum (Scribner et al., 2008).

Individual characteristics. Several student-level demographic and social variables were used as control variables in the multivariate regression analyses: sex, age (younger than age 21 vs. age 21 or older), class year, race/ethnicity (African American/Black, Asian, Hispanic/Latino, other, and White), student status (full vs. part time); grade-point average (4-point scale, A = 4.00), type of residence (residence hall/dormitory vs. fraternity/sorority house, house/apartment, or other), living situation (with roommate[s] vs. alone or with family/others), and timing of survey completion (before vs. during/after spring break). These variables known to be associated with college drinking were also used as control variables in multivariate regression analyses: weekly participation in fraternity/sorority activities (6 or more hours vs. fewer than 6); weekly participation in intercollegiate athletics (6 or more hours vs. fewer than 6); heavy episodic drinking, defined as consuming five or more (men) or four or more (women) drinks in a sitting in the last 2 weeks (yes/no); alcohol use in high school (0 = *abstainer,* 1 = *light drinker,* 2 = *moderate drinker,* 3 = *heavy drinker,* and 4 = *problem drinker*); and attitude toward drinking, using a 4-point scale (1 = *drinking is never good,* 2 = *drinking is alright but shouldn't get drunk,* 3 = *occasionally getting drunk is okay as long as it doesn't interfere with academics or other responsibilities,* and 4 = *occasionally or frequently getting drunk is okay even if it interferes with responsibilities*).

Campus-level measures

Intervention effect. The impact of the SNM intervention was taken into account by including both the first-order effect of the intervention at the campus level (treatment vs. control school) and the interaction between treatment and time (Years 1-4) at the individual level in the analyses.

Campus alcohol environment. Alcohol outlet density was computed as the number of on-premise outlets (i.e., bars, taverns, and restaurants) within 3 miles of the campus boundary per 1,000 graduate and undergraduate students enrolled. Off-campus bars—but not off-campus liquor stores—are cited by college students as one of their leading sources of alcohol (Harford et al., 2002; Wechsler et al., 2002c). Off-premise outlets were excluded because a very small number of liquor and convenience stores could supply a campus community, even one with several thousand undergraduates. All of the alcohol that students provide their peers could be purchased from one of just a handful of outlets or, in some campus communities, from a single outlet.

Outlet data were obtained from the alcohol control board of each state where the 32 institutions were located. Using the MapInfo 8.0 software program (MapInfo Inc., 2004) the states' active license files for 2004 were geocoded to trade address and then georeferenced using the defined campus buffer zones. An overall geocode rate of 96% was obtained for on-premise alcohol outlets within the specific county (or counties) in which a campus and its 3-mile buffer zone were located. One state could not provide license data, and project staff visited the affected site to make a direct count of the on-premise outlets within the buffer.

City population. The size of the surrounding city in which each campus resides—categorized as small (<100,000), medium (100,000-200,000), or large (>200,000)—was taken into account.

Statistical analyses

Multilevel modeling was used to determine whether on-premise alcohol outlet density moderated the effect of the

SNM campaigns on student drinking outcomes. Students by year were nested within treatment and control group campuses, which were characterized by the on-premise outlet density in their surrounding community. The moderating effect of outlet density was introduced into the models as an interaction between the treatment effect (i.e., the effect of the SNM campaigns over time) and on-premise outlet density. The models were then stratified by campus alcohol outlet density, based on the median level of density (high = at or above the median, low = less than the median level of density), to examine the effect of the intervention in each type of setting. Both crude and adjusted models were run, controlling for individual characteristics that were predictive of consumption in the original two SNMRP study reports (DeJong et al., 2006, 2009) as well as potential confounders.

Two campus-level variables of note were excluded from these analyses. First, message dosage had been assessed in the two SNMRP investigations using an omnibus measure of campaign intensity, the average weekly activity score (AWAS). As reported previously, the campaigns in the second study (the replication failure) were on average far more active than the campaigns in the first study (DeJong et al., 2009). In total, only three of the nine treatment group sites in the first study had an AWAS above the overall median, compared with five of seven sites in the replication study. The AWAS for the original study sites was 3.2 (*SD* = 1.0), compared with an AWAS of 4.2 (*SD* = 1.8) for the replication study sites. In sum, the AWAS was not predictive, and therefore the variable was omitted from the multilevel models.

Second, the size of undergraduate enrollment was excluded. Critics of SNM have asserted that students may be unlikely to identify with the student body as a whole and instead pay attention to small group norms (Keeling, 1999). This implies that SNM campaigns could be less successful on large campuses. That was not the case: 71.4% of the 14 study sites in the second study (the replication failure) had undergraduate enrollments of fewer than 10,000 students, compared with only 33.3% of the 18 sites in the second study (DeJong et al., 2009). Given this result, student body size was omitted from the multilevel models.

All analyses were done on data weighted for each year's survey to account for differences in sample sizes across schools. SAS Version 9.1 (SAS Institute Inc., Cary, NC) was used for all analyses, including PROC MIXED or GLIMMIX for hierarchical models. For each model the intraclass correlation coefficient (ICC) and Akaike Information Criterion (AIC) were calculated. The ICC is an estimate of the amount of variance in the outcome that is attributable to random effects at different levels—in this case, between-campus differences versus between-individual differences. The AIC is a measure of model fit, in which a smaller number indicates better fit.

Results

Table 1 presents a sociodemographic profile of the 19,763 respondents from the 32 participating colleges. The majority of students were female (61.1%) and of White racial background (76.9%). Nearly half of the respondents (48.3%) were younger than 21 years of age. Most respondents were full-time students (92.3%), residing either in residence halls/dormitories (i.e., on campus) or in homes or apartments. The majority indicated they had roommates (58.5%). Approximately one fifth of students (18.3%) were fraternity/sorority members or pledges, and 7.5% participated in intercollegiate athletics. No major differences in the sociodemographic profile between treatment and control campuses were noted, except with regard to residence type and living situation where treatment campus students were less likely to live in residence halls (33.8% vs. 40.0%) or live with roommates (55.4% vs. 61.5%).

With respect to alcohol consumption, approximately half (54.1%) of the students reported drinking during high school, with 29.3%, 17.3%, and 7.5% classified as light, moderate, and heavy or problem drinkers, respectively. The mean number of drinks consumed when partying was 3.9 (*SD* = 3.6), and the mean number of drinking occasions in the past 30 days was 5.7 (*SD* = 7.9). No major differences in the drinking outcomes were observed between treatment and control campuses.

At the campus level, the mean on-premise alcohol outlet density was 26.8 per 1,000 enrolled (*SD* = 33.2, range: 2.34-128.0). The treatment campuses had a slightly higher density of on-premise outlets (29.6 per 1,000) compared with the control campuses (24.2 per 1,000).

Table 2 presents the results of the multilevel analyses of drinking outcomes that were executed to assess the potential treatment effect modification caused by on-premise alcohol outlet density. Shown for each drinking outcome is (a) the full model for an initial test of effect modification, which features the interaction between the treatment effect (Treatment × Time) and on-premise outlet density, and (b) a multivariate model that examines the impact of treatment, stratified by high versus low on-premise outlet density. All multivariate models controlled for individual characteristics that predicted consumption in the original two SNMRP study reports (DeJong et al., 2006, 2009) and the following potential confounders: sex, race/ethnicity, class year, age, time of survey collection, student status (full or part time), grade-point average, residence location and type, living situation, relationship status, number of student friends, fraternity/sorority participation, varsity athletic participation, alcohol use in high school, and parental education.

For three of the four outcomes, the full models with relevant cross-level interaction terms reveal evidence of effect modification by on-sale alcohol outlet density for the effect of the intervention over time. This reached statistical signifi-

TABLE 1. Sociodemographic characteristics of students (N = 19,838)

Variable	Treatment % or *M* (*SD*)	Control % or *M* (*SD*)	Total % or *M* (*SD*)	Total *n*
Sex				
Male	37.9%	39.6%	38.9%	7,664
Female	62.1%	60.4%	61.1%	12,099
Race/ethnicity				
African American/Black	6.7%	6.2%	6.5%	1,271
Asian	8.5%	9.7%	9.2%	1,802
Hispanic/Latino(a)	9.4%	5.5%	7.4%	1,452
Other	5.0%	4.7%	4.7%	957
White	74.7%	79.0%	76.9%	15,149
Age				
<21 years old	50.1%	52.1%	48.3%	9,622
≥21years old	49.9%	47.9%	51.7%	10,056
Class year				
Freshman	23.6%	23.0%	23.3%	4,596
Sophomore	21.2%	22.3%	21.7%	4,299
Junior	25.9%	25.4%	25.7%	5,075
Senior	29.3%	29.3%	29.3%	5,801
Student status				
Full time	91.4%	93.2%	92.3%	18,179
Part time	8.6%	6.8%	7.7	1,513
Grade-point average				
A	31.9%	35.0%	33.5%	6,609
B	53.7%	51.4%	52.5%	10,359
C or below	14.4%	13.5%	14.0%	2,750
Residence type				
Residence hall/dormitory	33.8%	40.0%	38.0%	7,290
Fraternity/sorority house	2.1%	2.0%	2.1%	403
House/apartment	62.4%	56.6%	58.3%	11,709
Other	1.8%	1.4%	1.6%	312
Living situation				
With roommate(s)	55.4%	61.5%	58.5%	11,520
Alone	9.7%	11.8%	10.8%	2,120
With family/others	34.9%	26.7%	30.7%	6,042
Fraternity/sorority membership				
Fraternity/sorority member or pledge	19.7%	17.0%	18.3%	3,483
Not a fraternity/sorority member	80.3%	83.0%	81.7%	15,522
Athletics				
Intercollegiate athlete	7.3%	7.6%	7.5%	1,406
Not intercollegiate athlete	92.7%	92.4%	92.5%	17,517
Alcohol use in high school				
Drinker	53.8%	54.2%	54.1%	10,493
Abstainer	46.2%	45.8%	45.9%	9,000
Alcohol consumption				
No. of drinks per week	5.3 (8.4)	5.6 (8.7)	5.4 (8.6)	19,682
No. of drinks when partying	3.8 (3.6)	3.9 (3.6)	3.9 (3.6)	19,838
Maximum recent consumption	4.32 (5.07)	4.3 (5.0)	4.3 (5.0)	19,540
Composite drinking scale	0.04 (3.63)	0.1 (3.6)	0.1 (3.6)	16,695
Campus alcohol environment (N = 32)				
No. of on-sale outlets per 1,000 students enrolled	29.6 (34.8)	24.2 (31.5)	26.8 (33.2)	

Notes: All differences between treatment and control campuses were nonsignificant, with two exceptions: residence type, where treatment campus students were significantly ($p < .05$) less likely to (a) live in residence halls or (b) live with roommates.

cance for number of drinks when partying and approached statistical significance for maximum recent consumption and the composite drinking scale.

To better characterize the nature of the interactions involving on-sale outlet density, separate stratified analyses were performed for the same outcomes on high- and low-density campuses. The stratified analyses showed that the significant intervention effects were observed exclusively on the campuses with low on-premise alcohol outlet density for number of drinks when partying and the composite drinking scale, whereas there was a marginally significant result for maximum recent consumption and a small but nonsignificant result for number of drinks per week. Among the high on-premise alcohol outlet density campuses, in contrast, none of the effects of the intervention over time was significant.

TABLE 2. Multilevel analyses of drinking outcomes: Effect modification by on-premise alcohol outlet density (3-mile radius)

Variable	Full adjusted[a] model with interaction term	Impact of treatment: Campuses with high on-premise density[b]	Impact of treatment: Campuses with low on-premise density[b]	Full adjusted[a] model with interaction term	Impact of treatment: Campuses with high on-premise density[b]	Impact of treatment: Campuses with low on-premise density[b]
	No. of drinks when partying			No. of drinks per week		
n	19,671	9,703	9,968	19,682	9,707	9,975
Intercept	4.6485‡	4.0209‡	3.2889‡	8.0429‡	6.3527‡	4.4864‡
Fixed effects (regression coefficient, β)						
School-level variables						
On-premise alcohol density per 1,000 enrolled[c]	0.0341*			0.01162		
City population[b]	-0.5648**			-1.5117**		
Treatment (vs. control)	-0.08735	0.4598	-0.3965	-1.2472	0.5265	-1.2128
Treatment × On-Premise Alcohol Density	0.003895			0.03797§		
Student-level variables						
Time (Year 1-4)	0.05100‡	0.06624	0.2108‡	0.1682	-0.06399	0.2074**
Cross-level interactions						
Treatment × Time	-0.03520**	-0.00915	-0.1941**	-0.1394	0.1690	-0.1794
Time × On-Premise Density	-0.00052**			-0.00326		
Treatment × Time × On-premise Density	0.0032**			0.004634		
Random effects						
ICC	5.60	4.80	6.80	5.76	6.51	6.88
Goodness of fit						
AIC	105,445.4	52,430.8	52,939.4	138,916.5	70,246.4	68,183.1
	Composite drinking scale			Maximum recent consumption		
n	19,838	9,778	10,060	19,540	9,653	9,887
Intercept	1.0569**	0.4484	0.5044‡	5.5091‡	4.6442‡	3.5158‡
Fixed effects (regression coefficient, β)						
School-level variables						
On-premise alcohol density per 1,000 enrolled[c]	0.006704			0.006683		
City population[d]	-0.6540‡			-0.8310**		
Treatment (vs. control)	-0.4850	0.2979	-0.5034	-0.5740	0.5772	-0.6540
Treatment × On-Premise Alcohol Density	0.01648			0.02303§		
Student-level variables						
Time (Year 1-4)	0.1433‡	0.008723	0.1645‡	0.2253‡	0.01906	0.2741‡
Cross-Level Interactions						
Treatment × Time	-0.09793§	0.008723	-0.1253*	-0.1294§	0.08310	-0.1590§
Time × On-Premise Density	-0.00193*			-0.00258§		
Treatment × Time × On-Premise Density	0.002402§			0.002957§		
Random effects						
ICC	6.85	6.67	7.93	5.61	6.15	6.76
Goodness of fit						
AIC	105,379.3	52,861.9	52,356.2	117,170.8	58,745.8	58,268.7

Notes: ICC = intraclass correlation coefficient; AIC = Akaike Information Criterion. [a]Controlling for individual characteristics found to be predictive of consumption in primary intervention evaluation and potential confounders, including sex, race/ethnicity, class year, age, time of survey collection, student status (full or part time), grade-point average, residence location and type, living situation, relationship status, number of student friends, fraternity/sorority participation, varsity athletic participation, alcohol use in high school, and parental education; [b]*high density* defined at or above the median on-premise density (10.78 per 1,000 enrolled); *low density* defined as on-premise density below the median; there were similar results when using mean density (23.62 per 1,000 enrolled); [c]on-premise density = number of on-premise outlets within a 3-mile radius from the campus boundary, per 1,000 enrolled; [d]city population was categorized as small (<100,000), medium (100,000-200,000), or large (>200,000).
§$p < .10$; *$p < .05$; **$p < .01$; ‡$p < .0001$.

Discussion

In examining the impact of the campus alcohol environment on SNM campaigns, we found that the density of on-premise alcohol outlets within 3 miles of campus modified the intervention effects observed in the SNMRP. Specifically, there was a significant interaction between the treatment effect and on-premise alcohol outlet density for the most frequently drinking outcome targeted by the SNM campaigns—the number of drinks when partying—and marginally significant evidence of this interaction for maximum recent consumption and the composite drinking scale. In stratified analyses, intervention effects were observed only among students from campuses with lower on-premise alcohol outlet density, whereas no intervention effects were observed among students from campuses with higher on-premise alcohol outlet density.

These findings help explain the different results for the

two previously published SNMRP evaluations. The first study showed that, controlling for other predictors, having a SNM campaign was significantly associated with lower alcohol consumption, as measured by a composite drinking scale, recent maximum consumption, blood alcohol concentration for recent maximum consumption, drinks when partying, and drinks per week (DeJong et al., 2006). As it turns out, 13 of the 18 participating colleges (six treatment group sites, seven control group sites) were located in communities with a relatively *low* on-premise alcohol outlet density (i.e., *below the median density* for the 32 SNMRP sites). The second study failed to replicate the first study's findings. The reason may have been that fully 11 of the 14 participating colleges (six treatment group sites, five control group sites) were located in communities with a relatively *high* on-premise alcohol outlet density (i.e., *at or above the median density* for all 32 sites).

Study limitations

First, although the intervention effect and therefore the interaction of the intervention effect with on-sale alcohol outlet density was found for three of the drinking outcomes, it was marginally significant (i.e., $.5 < p < .10$) for two of those outcomes. It should be noted that this was a secondary analysis of an existing data set that was not designed to include so many campus-level covariates in a multilevel design given the relatively small number of level two units ($N = 32$ campuses). As a result, the number of campus-level covariates may have underpowered the analysis. It should be noted, however, that all the observed effects for the four outcomes trended in the same direction. Nonetheless, the findings need to be replicated to provide assurance that the results were not isolated or specific to the type of SNM intervention used in the SNMRP.

Next, other types of venues associated with alcohol use (i.e., private parties, fraternity parties) were not accounted for in the analysis. Consequently, the analysis assumes nondifferential exposure to other alcohol use venues for students across campuses. This may or may not be a reasonable assumption and future studies should account for these venues as a potential confounder.

Finally, these findings apply only to SNM campaigns that match the SNMRP's guidelines (DeJong et al., 2006). Also, consider that the SNMRP campuses received start-up funds of only U.S. $2,000 per year, with supplemental funds of $300 to $1,650 per campus awarded for the second and third years, depending on the level of need identified through an application process. Some campuses relied entirely on this funding, but others secured in-kind contributions (e.g., free or discounted advertising space) and small cash gifts. (One exceptional site was able to bring 1 year's campaign budget up to $13,650).

Implications for prevention practice

It is not yet clear how college officials who work in a campus community with high off-campus alcohol outlet density should apply the present findings. Given that this is an exploratory study, the answer will depend on future research detailing the nature of the potential effect of alcohol outlet density on student misperceptions of drinking norms.

One possibility for an effect of alcohol outlet density on student misperceptions involves the physical presence of alcohol outlets near campus. Neon signs, storefront advertising, and direct observation of heavy drinking may convey their own normative message to students, thereby heightening student misperceptions of peer drinking norms. If this is the case, then campus officials working in a community with higher alcohol outlet density would want to implement a more extensive SNM campaign than what the SNMRP treatment group sites were able to mount.

A contrasting possibility is that higher off-campus alcohol outlet density serves to *reduce* student misperceptions of peer drinking norms. Higher outlet density means easier student access to alcohol and more opportunities to drink, and, indeed, several studies have documented that campuses with higher off-campus alcohol outlet density have greater levels of student drinking (Scribner et al., 2008; Wechsler et al., 2002a; Weitzman et al., 2003). At the same time, it is possible that higher outlet density, by encouraging public drinking, might also give students more opportunities to observe and accurately perceive student drinking levels in that campus community. Thus, the level of misperception that SNM campaigns have available to correct may be more limited on such campuses.

Clearly, to guide prevention practice, research is needed to clarify how the campus alcohol environment affects student perceptions of peer drinking norms.

References

Borsari, B., & Carey, K. B. (2001). Peer influences on college drinking: A review of the research. *Journal of Substance Abuse, 13,* 391-424.

DeJong, W., Schneider, S. K., Towvim, L. G., Murphy, M. J., Doerr, E. E., Simonsen, N. R., . . . Scribner, R. A. (2006). A multisite randomized trial of social norms marketing campaigns to reduce college student drinking. *Journal of Studies on Alcohol, 67,* 868-879.

DeJong, W., Schneider, S. K., Towvim, L. G., Murphy, M. J., Doerr, E. E., Simonsen, N. R., . . . Scribner, R. A. (2009). A multisite randomized trial of social norms marketing campaigns to reduce college student drinking: A replication failure. *Substance Abuse, 30,* 127-140.

Harford, T. C., Wechsler, H., & Seibring, M. (2002). Attendance and alcohol use at parties and bars in college: A national survey of current drinkers. *Journal of Studies on Alcohol, 63,* 726-733.

Keeling, R. P. (1999). Proceed with caution: Understanding and changing norms. *Journal of American College Health, 47,* 243-246.

MapInfo Inc. (2004). *MapInfo Professional 7.0,* Troy, NY: Author.

Perkins, H. W., & Berkowitz, A. D. (1986). Perceiving the community norms of alcohol use among students: Some research implications for

campus alcohol education programming. *International Journal of the Addictions, 21,* 961-976.

Perkins, H. W., Haines, M. P., & Rice, R. (2005). Misperceiving the college drinking norm and related problems: A nationwide study of exposure to prevention information, perceived norms and student alcohol misuse. *Journal of Studies on Alcohol, 66,* 470-478.

Scribner, R., Mason, K., Theall, K., Simonsen, N., Schneider, S. K., Towvim, L. G., & DeJong, W. (2008). The contextual role of alcohol outlet density in college drinking. *Journal of Studies on Alcohol and Drugs, 69,* 112-120.

Wechsler, H., Lee, J. E., Hall, J., Wagenaar, A. C., & Lee, H. (2002a). Secondhand effects of student alcohol use reported by neighbors of colleges: The role of alcohol outlets. *Social Science and Medicine, 55,* 425-435.

Wechsler, H., Lee, J. E., Kuo, M., Seibring, M., Nelson, T. F., & Lee, H. (2002b). Trends in college binge drinking during a period of increased prevention efforts. Findings from 4 Harvard School of Public Health College Alcohol Study surveys: 1993-2001. *Journal of American College Health, 50,* 203-217.

Wechsler, H., Lee, J. E., Nelson, T. F., & Kuo, M. (2002c). Underage college students' drinking behavior, access to alcohol, and the influence of deterrence policies. Findings from the Harvard School of Public Health College Alcohol Study. *Journal of American College Health, 50,* 223-236.

Wechsler, H., Nelson, T. E., Lee, J. E., Seibring, M., Lewis, C., & Keeling, R. P. (2003). Perception and reality: A national evaluation of social norms marketing interventions to reduce college students' heavy alcohol use. *Journal of Studies on Alcohol, 64,* 484-494.

Weitzman, E. R., Folkman, A., Folkman, M. P., & Wechsler, H. (2003). The relationship of alcohol outlet density to heavy and frequent drinking and drinking-related problems among college students at eight universities. *Health Place, 9,* 1-6.