

## Two Studies Examining Environmental Predictors of Heavy Drinking by College Students

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Two sequential studies are presented that examine the validity of a set of environmental variables to predict heavy drinking at college students' most recent drinking occasions. Random telephone interviews ( $n = 1609$ ,  $n = 400$ ) of graduate and undergraduate students attending two large public universities in the southwestern United States were conducted during three separate surveys in 2000 and 2001. An original interview schedule was used and it included measures that examined environmental characteristics of students' most recent drinking events, motivations for drinking, demographics, and alcohol consumption. Using nonparametric exploratory and confirmatory discriminant analyses to distinguish between heavy episodic and nonheavy episodic drinking events, a discriminant function was identified that included the following environmental variables: (1) having many people intoxicated at an event, (2) having illicit drugs available at an event, (3) BYOB events and, (4) the playing of drinking games at the event. The validity of these environmental variables to predict heavy drinking among students was supported in a subsequent study examining a separate sample from the same student population. Environmental factors can be useful to predict heavy drinking events experienced by students. Prevention programs would benefit from targeting such factors in combination with more traditional individual-level approaches.

**KEY WORDS:** heavy drinking; college students; environmental factors.

Researchers have long understood the importance of the physical and social environments as they relate to alcohol consumption within the college student population. In their seminal study of college students' drinking habits, Straus and Bacon (1953) examined the contexts of college students' drinking behavior. They examined when, where, and with whom students drank as well as what they drank. Similar to college students studied a half century later (Clapp & Shillington, 2001), Straus and Bacon found students commonly drank in both public (bars) and

private settings (apartments) and preferred beer to other beverages.

Since the Straus and Bacon study, however, there has been surprisingly little research examining the relationship between drinking environments and drinking behavior in college settings. Despite this dearth of research, colleges and universities are increasingly adopting environmental approaches to prevent alcohol-related problems experienced by students (Wechsler *et al.*, 2000), as many universities recognize that individual-level approaches may not be feasible at large universities where alcohol-related problems and heavy drinking are widespread.

In the college alcohol-prevention field, environmental prevention is a loosely defined set of strategies that typically include coalition building, social norms correction campaigns, policy development, responsible-beverage-service-(RBS), and law-enforcement (Clapp *et al.*, 2001; DeJong *et al.*, 1998). Conceptually, environmental factors range from macro (laws

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and policies) to micro (event-specific characteristics), with corresponding prevention strategies. Such strategies target the environment (e.g., policies and laws) or populations (e.g., normative campaigns and targeted law enforcement) but vary widely in their definition, quality, and implementation.

One reason for such inconsistency is that the environmental alcohol-prevention field is in a nascent stage of development. Although the Community Trials Project illustrated that environmental approaches can be effective in reducing alcohol-related problems at the community level (Treno & Holder, 1997), such approaches are underdeveloped for use in college campuses and communities. To that end, theories and conceptual models, valid and reliable measures of the alcohol environment, and proven interventions are limited.

Although much work is needed to guide and enhance environmental prevention efforts, there is cogent evidence that such efforts are warranted. There is a fair amount of research examining the relationship between drinking contexts and alcohol consumption in noncollege populations. Harford (1979), for instance, found that heavier drinking tended to occur in public settings. In a latter study using national (U.S.) data, Hilton (1991) reported that across all alcohol consumption patterns (i.e., abstainer, light, moderate, heavy) contexts that included the presence of coworkers, close friends, and neighbors tended to be "wetter." Similarly, Hilton (1989) reported that men drank more than women did in both public (bars, restaurants, etc.) and private (parties and homes) contexts.

In a recent national study of over 8,000 Canadian students, Demers *et al.* (2002) found that environmental/situational factors and individual factors contributed almost equal amounts of variance when modeling students' alcohol consumption. They found drinking in bars, at parties, and in larger groups (especially for females) were related to heavy drinking by college students.

In a survey of 409 college students, Clapp and Shillington (2001) reported that drinking beer or hard liquor, having many people intoxicated at a drinking event, and having school friends present at a drinking event were predictive, net of other covariates, of heavy episodic drinking (five or more drinks in a row). In another study, Clapp *et al.* (2000) examined environmental predictors of alcohol-related problems within 110 college students' heavy episodic drinking events. By computing a series of multivariate logistic regression models, Clapp and associates found that, overall, the availability of illicit drugs was associated

with an increased risk for alcohol-related problems, while having school friends present and food available at drinking events were protective of such problems. These associations differed by sex though. For males, playing drinking games was also a significant risk factor for alcohol problems. For women, the presence of a roommate at the event was protective of problems. Along similar lines, Wechsler *et al.* (2000) reported that living in a fraternity or sorority, access to inexpensive alcohol, and drinking beer were predictive of heavy episodic drinking.

In the present studies, we build on this earlier work by attempting to validate those findings. This paper also augments the current literature in this area by presenting findings from two sequential studies that examine the relationship of environmental characteristics related to heavy drinking among college students. The studies build on each other by first examining the relationship between environmental variables and heavy episodic drinking, then confirming these relationships using a different data set while taking individual-level variables into account. Together, these studies begin to establish the predictive validity of a set of environmental characteristics related to heavy drinking events attended by college students.

## STUDY ONE

In this study, we use both exploratory and confirmatory discriminate models to test the ability of a set of environmental variables to distinguish between heavy episodic and nonheavy episodic alcohol consumption by college students during their most recent drinking occasion. Environmental factors were selected based on previous research (Clapp & Shillington, 2001).

### Methods

A random telephone survey of graduate and undergraduate students attending two large public universities in the southwestern United States was conducted during the Spring and Fall semesters of 2000 (regular school year). A university-based social science research laboratory conducted the telephone interviews. At least 400 students were randomly selected from registration records and interviewed at each school, each semester for an overall sample of 1609 students. For both schools, a sample of 400 students allowed for 95% confidence ( $\pm 5\%$ )

when estimating population parameters. Preliminary analyses of the data from the two universities indicated that the schools do not differ on any of the last drinking event or drinking variables assessed here. As such, the data from the two schools were pooled for analysis.

Women constituted the majority (55%) of the sample, and participants from all class levels were represented. Seniors made up the largest percentage of participants (26.8%) and sophomores made up the smallest percentage (15.4%). Freshman, juniors, and graduate students each made up between 17.3 and 20.8% of the remaining sample.<sup>5</sup> Participant ages ranged from 18 to 61, with a mean age of 24.4 and a median age of 22. This sample included White students (51%), African American students (4.2%), Hispanic students (30.1%), Asian students (8.1%), and Native American students (1.8%).

An original interview schedule was developed for this study. The instrument included several items from the Core Survey (Presley *et al.*, 1995) including measures of AOD use and related problems. Presley *et al.* (1995) reported the psychometric properties of the Core were acceptable. This instrument is used widely in college alcohol research. In addition to the standard questions taken from the Core Survey, we included a series of questions measuring contexts of student drinking (see Clapp *et al.*, 2000). We drew several of the context items from the College Alcohol Risk Assessment Guide (Ryan *et al.*, 1994). Finally, we developed several original items designed to assess environmental characteristics of student drinking events (Clapp *et al.*, 2000; Clapp & Shillington, 2001).

### Measures

*Environmental Predictor Variables.* As part of this survey, respondents were asked to recall and describe characteristics of the last occasion (within the past 28 days) that they attended in which alcoholic beverages were served and at which they drank at least one alcoholic beverage. Participants indicated the nature of the event (i.e., whether it was a

fraternity party, nonfraternity party, social gathering with friends or family, etc.) as well as the type of location at which the event took place (i.e., someone's home, restaurant, bar or nightclub, etc.). Additionally, respondents indicated which of a number of different environmental characteristics were present. The particular environmental features assessed included the availability of alternative activities besides alcohol (i.e., food), the availability of drugs, beverage service (e.g., BYOB, served by a bartender, etc.), characteristics of the other event attendees (e.g., level of intoxication, gender make-up, etc.) and the presence of structured drinking-related activities (i.e., drinking games).

*Dependent Measure.* Finally, in addition to describing the event, participants were asked to indicate the number of drinks that they consumed during the event. Note that at the beginning of the survey, a "drink" was operationally defined as equaling one 12-oz can, bottle, or glass of beer; a 5-oz glass of wine; or a 1-oz shot of hard liquor, such as vodka, whisky, or gin. For analysis purposes, we recoded this continuous measure into a dichotomous variable reflecting whether the event was a heavy drinking episode (five or more drinks) or not. This definition of heavy episodic or binge drinking is used by two of three national studies of college drinking (Presley *et al.*, 1995; Johnston *et al.*, 1999) and is consistent with our previous work (Clapp & Shillington, 2001).

### Analytic Strategy

Our primary concern in this case was establishing the overall predictive validity of a set of environmental variables related to heavy episodic drinking. For that reason, regression-based techniques did not seem appropriate as the parameter estimates produced by such analysis likely would be attenuated by the other predictors in the model. Consequently, discriminant analysis was employed to test whether the environmental event variables could significantly and successfully predict heavy episodic drinking. However, because our predictors were categorical (they were effect-coded), assumptions of multivariate normality were tenuous. Therefore, a nonparametric estimation procedure within SAS (version 8.0) was used to conduct the analysis.

Analysis involved both an exploratory and a confirmatory phase. The data were randomly split into two subsets using the random number generator within SPSS (version 10.1). One subset was assigned

<sup>5</sup>Our sample included both undergraduates and graduate students. It is possible that these two groups represent different populations regarding drinking and environmental factors. However, analysis revealed that event features significantly predicted heavy drinking both for undergraduates ( $F = 8.1$ ,  $df = 12, 476$ ,  $p < .01$ ) and graduate students ( $9F = 3.9$ ,  $df = 12, 84$ ,  $p < .01$ ). Error rates were comparable as well (9.5–4.3%).

Table 1. Pooled Within-Group Structure Coefficients for the Exploratory and Confirmatory Subsamples

Environmental variable	Exploratory subsample	Confirmatory subsample
	<i>s</i>	<i>s</i>
Food was available	-.30	-.12
Alcohol served by bartender	-.23	-.13
Many people intoxicated	.70	.66
Illegal drugs available	.55	.39
No-cost alcohol provided	-.06	-.12
Didn't know many people	.09	.05
BYOB event	.38	.30
Drinking games were played	.62	.63
All attendees same sex	-.15	-.02

Note. Bold coefficients are considered meaningful to the discriminant function.

to be exploratory data while the other was assigned to be confirmatory data. The analytic procedure first estimated discriminant functions (predicting heavy episodic drinking from the environmental event variables) from the exploratory data. Then, in a second procedure, the analysis applied the same discriminant function to the confirmatory data set to test the function's ability to successfully classify participants as heavy episodic drinkers. We then computed pooled within-subject structure coefficients for the confirmatory data for comparison purposes.

## Results

The discriminant analysis procedure could only analyze cases in which there were no missing values for the variables in the model. In the exploratory data set, there were 586 usable cases. The predictor variables in the discriminant analysis were responses to the nine environmental questions as well as dichotomous variables pertaining to whether: the event was (a) Private or Public, (b) whether the event purpose was to "Party" or to "Socialize," and (c) a variable which represented the interaction between the latter two. Events were categorized as Public if they took place in a bar, restaurant or club, and Private if they took place in a home or an apartment. Participants' identification of events as a Fraternity party, non-Fraternity party or Social event with friends or family was used to categorize the event purpose as to Party or to Socialize.

Discriminant analysis revealed that the set of predictor variables did significantly predict heavy episodic drinking among individual participants, multivariate  $F(12, 573) = 10, p < .01$ . The pooled-within canonical structure coefficients are provided

in Table 1. These structure coefficient are analogous to "factor loadings" in principle components analysis and reflect the simple correlations between the predictor variables and the discriminant function. Typically, loadings above .30 (in absolute magnitude) are considered substantive (Hair *et al.*, 1992). The results reveal that the presence of many intoxicated people, illegal drugs, and drinking games were all highly predictive of heavy episodic drinking. Events that were BYOB also presented a higher likelihood of heavy episodic drinking, while the availability of food was associated with a reduced likelihood of heavy episodic drinking. Given Private events (vs. Public) and Parties (vs. occasions of socializing) were each associated with a higher likelihood of participant heavy episodic drinking, we tested for the interaction between the two. The interaction, however, did not contribute to the discriminant function.

The discriminant function coefficients produced by this analysis were used to classify cases (using the nearest-neighbor approach) as heavy episodic or nonheavy episodic drinkers. The environmental predictor variables could successfully identify 94.8% of nonheavy episodic drinkers and 48% of the heavy episodic drinkers. The overall classification error-rate obtained from the discriminant analysis was 9.6%, or 53 misclassifications out of 550 classifiable cases.<sup>6</sup>

<sup>6</sup>There were 47 cases who reported having consumed 5 or more drinks but who were predicted (using the environmental variables) but were predicted to consume less than 5 drinks. These misses are a form of misclassification. There were also six participants who reported having fewer than 5 drinks but who were classified, as a function of the event features variables, as having consumed 5 or more drinks. These false "hits" are also misclassifications. Combined there were 53 misclassifications out of 550 total-classifiable observations, producing a 9.6% error rate. As a comparison, classifying observations using simply prior probabilities of heavy

The second half of the sample was used for the confirmatory stage of the analysis. The same discriminant function coefficients were applied to data from the confirmation data set to predict case classification. The overall classification error-rate associated with this confirmatory analysis was notably higher than in the exploratory analysis at 20.5% (i.e., 101 of the 493 classifiable cases).

When comparing the discriminant functions of the exploratory and confirmatory subsamples, all the statistically significant variables are the same with the exception of the food variable, which fell out of the confirmatory model. Variables positively related to heavy episodic drinking events included having many people intoxicated present, having illegal drugs available, and having drinking games being played. BYOB events were also more likely to result in heavy episodic drinking.

## Discussion

A discriminant function comprised of environmental event variables that distinguished among heavy episodic and nonheavy episodic drinking behavior was identified and statistically validated in a two-phase analysis. These findings support prior research on environmental factors related to heavy episodic drinking (Clapp *et al.*, 2000; Clapp & Shillington, 2001).

The finding that many people being intoxicated at the event contributed to whether the event was a heavy episodic event at an individual level suggests that a "party" atmosphere contributes to alcohol consumption and supports earlier findings (Clapp & Shillington, 2001). This may also be true for the finding that drinking games contribute to heavy episodic drinking. The exact dynamics underlying these variables are not clear. Further research is needed to examine both individual and environmental variables as they relate to heavy episodic drinking events. It is possible that there is a subtle reward system in place where one's peers at a party reinforce heavy drinking behaviors through social interactions that are supported by environmental characteristics.

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drinking (as opposed to the event features) yields a classification rate of 35.6% or 196 misclassified cases (out of 550). Thus the classification using the discriminant functions estimated from the event feature variables reduced the prior-probability error-rate by 73.0%.

As Hansen (1997, p. 157) noted, "according to the social influence model, substance use and misuse are functions of an individual's interaction with the immediate peer group." The process of participating in or observing drinking games, being at an event where many people are perceived to be intoxicated, or using drugs may have social rewards not measured here. Peers may support the heavy episodic drinking by approving of the drinking games or supporting each other in heavy drinking behaviors.

## STUDY TWO

In Study Two, we surveyed a new cohort of students and conducted analyses designed to confirm and expand on the results of Study One. To this end, we ran an exploratory factor analysis to examine the factor structure of several environmental variables using an algorithm in *Mplus* designed for categorical variables (Muthen & Muthen, 1998). Given that we identified latent constructs in the first phase of the analysis, and we had the ultimate goal of seeing how these constructs predicted drinking behaviors, we used structural equation models rather than ordinary least-square regression for the last phase of the analysis (Pedhauzer & Schmelkin, 1991). The variables loading in the factor were then entered into structural equation models that examined the relationships among drinking motivations, personal drinking history, environmental characteristics, and drinking behavior.

Drinking motivations were included in the structural equation models based on earlier work conducted by Lange and Voas (2000) who found that young adults are often motivated to seek out uncontrolled drinking environments that facilitate heavy drinking. Given this, we sought to examine the relationship between such motivations and the environmental factors identified earlier.

Finally, we included personal risk factors in the SEMs. In previous research we found that past drinking behavior is a strong predictor of future behavior as well as problems (Clapp & Shillington, 2001).

## Methods

Random telephone interviews were conducted during the summer session of 2001, with 402 undergraduate students attending one of the large public universities used in the previous study. The purpose

of this survey was to generate a sample of student drinking events that could be statistically modeled using the variables identified in Study One. Specifically, students were queried about their most recent drinking event (past month).

For the purposes of this confirmatory sample, we restricted the sample to students 18–22 years of age who had consumed alcohol at least once in the month prior to being surveyed. Similar to the previous study, interviews were conducted by trained interviewers at the same university based research laboratory. The interview schedule used in this study included the same items as Study One.

*Measures*

*Environmental Variables.* The environment was indicated by the three items found from the previous analysis to most strongly predict a heavy drinking experience—the presence of many intoxicated individuals, drugs, and drinking games. When initially included in the SEMs the BYOB variable and the variable reflecting whether or not food was present were not significant at the factor level. Thus we dropped them from the final analyses.

*Motivational Variables.* For this study, we also included a measure of respondents' motivations related to their most recent drinking event. This variable asked respondents whether they planned to (1) not drink, (2) drink and get a little buzzed, or (3) drink and get drunk. In addition, we asked re-

spondents to estimate the motivations of their drinking companions for that event using the same scale. In the SEMs presented below, motivations were indicated by self-reported intentions to get drunk at the occasion, and their beliefs about their friends plans to get drunk.

*Personal Risk Variables.* Personal risk was indicated by an average drink per occasion measure constructed from a set of drinking history questions and the number of times in the last two weeks the subject had consumed 5 or more drinks at a given occasion.

*Drinking Variables.* Drinking was indicated from the subjective rating of how drunk the subject reported feeling following the event, and the number of drinks consumed.

*Analysis Strategy*

The analyses were conducted in two phases. First, we conducted an exploratory factor analysis examining the same environmental variables used in the analysis presented in Study One. Second, we calculated three SEMs to examine the influence of environmental characteristics as they related to drinking behavior taking into account personal history and drinking motivations. We ran three models: (1) a full model in which all paths were allowed to vary freely (Fig. 1), (2) a model in which the path from motivation to drinking was set to zero (Fig. 2), and (3) a model in which the path from environment to drinking was set to zero (Fig. 3).

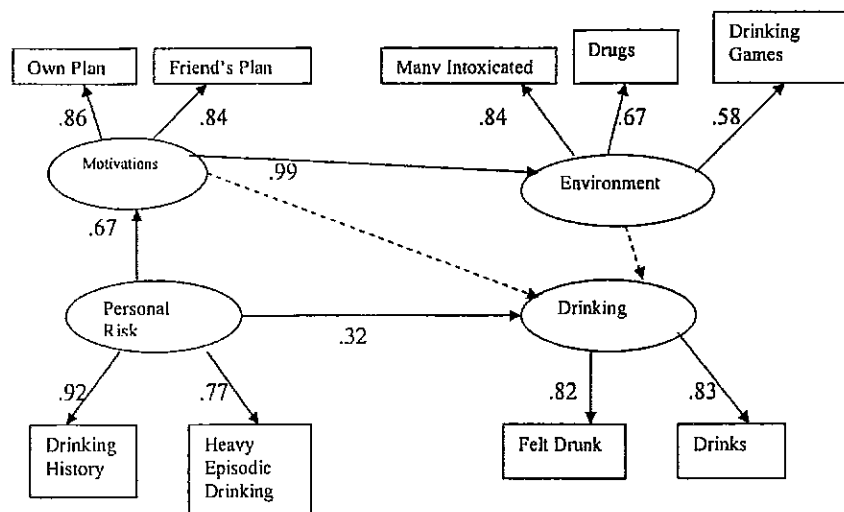


Fig. 1. Structural equation model of environment, personal characteristics, motivations and drinking (no constraints, nonsignificant paths in dashed line).

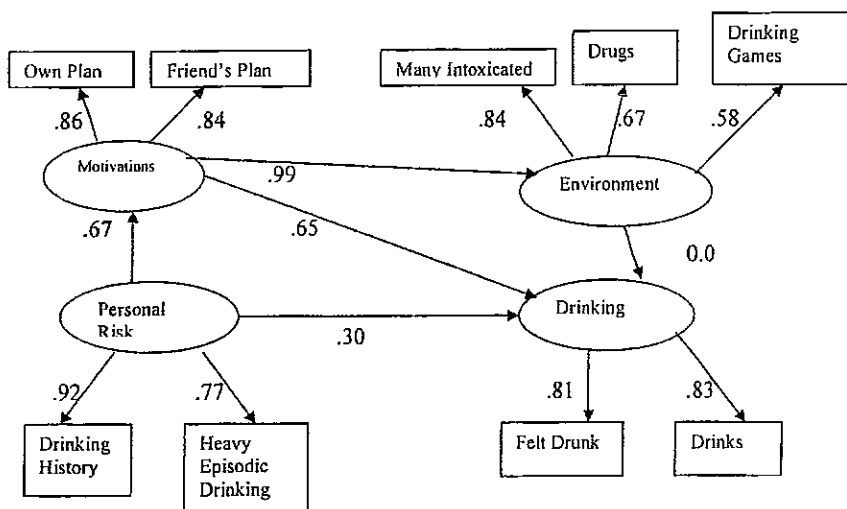


Fig. 2. Structural equation model of environment, personal characteristics, motivations and drinking (environment to drinking constrained).

Results

Eight items (Table 2) were selected to represent environmental characteristics present during student drinking events. To identify a clustering of those eight items we conducted an exploratory factor analysis using a dichotomous factor analysis model in *Mplus 2.0* (Muthen, 1989; Muthen & Muthen, 1998). This particular procedure generates a chi-square statistics for assessing the model fit.

The  $\chi^2$  value is expected to be nonsignificant for an acceptable model fit. As such, large or significant  $\chi^2$  statistics relative to the degrees of freedom associ-

ated with the model indicate that the model may not be a good representation of the data in the population (a poor fit), while the small or nonsignificant  $\chi^2$  statistics indicate a good or acceptable fit. Another fit index, the root mean square error of approximation (RMSEA) (Steiger & Lind, 1980) was used. For the RMSEA, values less than 0.05 are indicative of a better fit, with values in the range of 0.05–0.10 indicating fair or mediocre fit and above 0.10 a poor fit (Browne & Cudeck, 1993).

Table 2 presents results from dichotomous factor analysis on eight items. The factor solution was derived using Varimax rotation. Factor loadings above

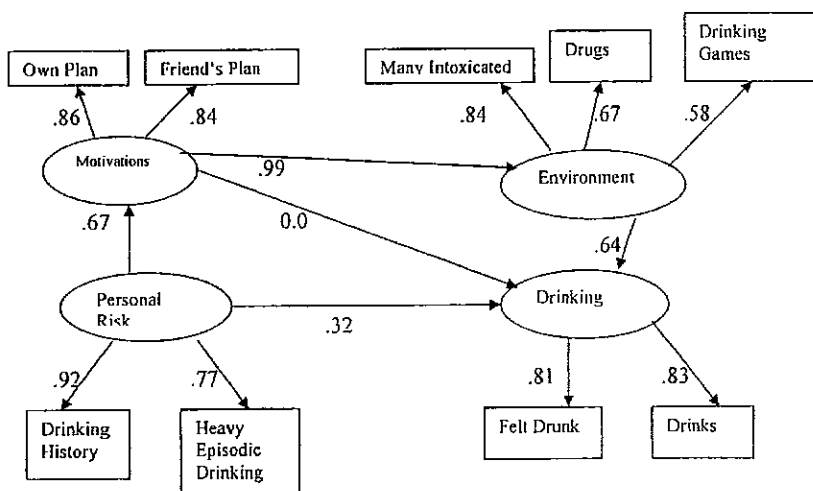


Fig. 3. Structural equation model of environment, personal characteristics, motivations and drinking (motivation to drinking constrained).

Table 2. Dichotomous factor analysis on environmental factors ( $N = 401$ )

	Factor 1 (Bar event)	Factor 2 (Party factors)
Event was in a bar	<b>1.40</b>	-.18
Event was BYOB	-.50	.46
No-cost alcohol was provided	-.48	-.05
Illicit drugs were available	-.09	.69
Food was available	-.32	-.47
Drinking games were played	-.21	.62
The group was same sex	-.12	.20
Many people were intoxicated	-.19	.64
$\chi^2 = 15.8, df = 11$		
RMSEA = .035		

Note. Bold loadings are considered important to the factor solution.

.45 were considered to have significant loadings on each factor. The results indicate that two-factor solution has the best fit for the data and the factor solution appears to explain eight items quite well, as indicated by nonsignificant chi-square statistics and RMSEA.

As can be seen, in the table, the variables loading on factor two were essentially the same as those that loaded on the discriminant function in Study One.

#### SEM Analysis

Latent variables were constructed for motivations, environment, alcohol consumption, and personal drinking risk. In almost all cases, the level of measurement for the observed variables was a dichotomous, yes/no dummy code. Given the dichotomous nature of the data and that we had latent constructs represented by two observed variables, we used estimation algorithm that allows for a mixture of categorical, ordinal, and continuous observed variables within the same model (Muthen & Muthen, 1998) within the *Mplus* 2.0 software package.

In all three SEMs, the path from motivations to environment was strong and significant. The path from the personal risk latent variable to the drinking variable was also statistically significant in each model but with a modest estimated regression coefficient. The path from personal risk to motivations was also statistically significant in each model with a moderately strong estimated regression coefficient.

#### Mediation Test

Of interest here is unique role of the environment on drinking. Two competing hypotheses were tested with the SEM modeling procedure: (1) The environment has a independent effect on the level of

drinking and (2), the environment facilitates motivations to drink. This method of testing for mediation is consistent with the approach outlined by Baron and Kenny (1986).

A model was tested including paths from both *motivations* and *environment* to *drinking*. When both constructs were in the model competing for variance, neither was statistically significant.

Next, we tested separate models constraining these paths individually by setting them to 0. The constrained models fit no better than the unrestrained model (RMSEA for each model = .06). Further, the paths between *motivations* and *environment* to *drinking* were only significant in the restrained models. This indicates environment likely serves as a mediator to motivations to drink.

#### Discussion

The results found in this study further support the results found in Study One. That is, key environmental factors appear to cluster together and play an important role in college students' drinking behavior. These findings support those found in previous studies examining the relationship between environmental variables and heavy episodic drinking (Clapp & Shillington, 2001).

Further, the findings of Study Two support the earlier findings of Lange and Voas (2000) who found that students often seek out environments with characteristics that facilitate heavy drinking. The relationships between such motivations, environmental characteristics, and personal risk factors are all important to college students' drinking behavior.

Drinking environments, however, represent the nexus of individual and environmental factors related to behavior and may represent "leverage points" that

remain critical to prevention and health promotion (Stokols, 2000). From both a research and prevention standpoint further understanding such how drinking behavior is influenced in such settings is important.

### CONCLUSIONS

This paper presented two studies conducted to examine the predictive validity of a set of environmental variables as they relate to heavy drinking. The findings of the two studies are fairly consistent. Specifically, the playing of drinking games, many intoxicated people and illicit drugs consistently predicted heavy drinking. Our results suggest that drinking settings containing these characteristics represent uncontrolled, high-risk environments for heavy alcohol consumption. Further, students actively seek out such environments. Although much more work is needed to better understand how such factors operate and interact with individual level variables and each other, the findings of the above studies suggest that specific environmental characteristics are important to understanding the etiology of heavy drinking among students.

Future studies would benefit from inclusion of more indicators of the social and physical environments in which college students drink. The data used in the present studies were collected as part of prevention trial. As such, the indicators reflecting environmental aspects of student drinking events are somewhat limited.

It will also be important for future research to include more individual level variables (measures of expectancies, for instance) as well as more direct measures of alcohol consumption in order to better model the relationship between consumption and problems. Future research should also query the issues associated with BYOB events being more likely heavy episodic events. It is possible that the availability, cost, and product preference all contribute to this relationship but this remains unclear.

A few other limitations should be kept in mind. First, these were self-report data. Although the validity of self-reports for alcohol-related behaviors has been established (Midanik, 1988), it is important to consider that self-report data assumes respondents can accurately report on both their own drinking behaviors and the characteristics of the event they attended. Future research should aim to also include independent observations of drinking events.

Second, the two universities included in this study are geographically unique, as both are located on the U.S./Mexico border. The present studies, therefore, need to be replicated other college populations to establish their external validity.

Finally, it is important to note that the motivation questions included in Study Two were asked retrospectively. This design may have influenced respondents' recall of motivations. That is, respondents might have attributed motivations to the event that were consistent with the outcome of the event on a post hoc basis.

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