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DIMENSIONALITY AND PSYCHOMETRIC ANALYSIS OF AN ALCOHOL PROTECTIVE BEHAVIORAL STRATEGIES SCALE*

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Abstract

Objective—The current study examined the dimensionality of a protective behavioral strategies (PBS) measure among undergraduate, predominantly freshmen (92.5%) college students reporting recent alcohol use (r = 320).

Method—Participants completed a web-based survey assessing 22 PBS items. Factor analyses determined the underlying factor structure of the items. Congruence of the factor structure among gender and racial sub-groups was examined by rotating the sub-groups' matrices via the Procrustes rotation method. Reliability analyses determined internal consistency.

Results—A 2-factor solution was retained utilizing 17 of the original items. Both PBS sub-scales (Limits and Avoidance) had acceptable internal consistency across all samples.

Conclusions—This PBS Scale was determined to be bi-dimensional and reliable. The dimensions suggest two underlying foci: ways to limit alcohol intake and ways to avoid alcohol intake while socializing. Practical implications of these findings are discussed.

INTRODUCTION

Alcohol is the most widely used drug among American youth. Recent data indicate that 63% of college students had used alcohol in the prior 30 days (ACHA, 2009), with 33% having binged within the prior 2 weeks (ACHA, 2009). Alcohol use rates have not declined over the past few decades sustaining an alarming rate of college students experiencing negative consequences as a result of their alcohol use. Negative consequences associated with alcohol use among college students have been categorized into health, personal, academic, legal, and financial problems (Park, 2004; Perkins, 2002; Reis, Trockel, & Wall, 2003; Wechsler, Lee, Nelson, & Kuo, 2002).

Because of the alarming rates of alcohol use and the multitude of negative alcohol-related consequences, a harm reduction approach has been adopted in recent years as a way to both understand and potentially address college students' alcohol use and the negative consequences that result. The Harm Reduction model is a secondary prevention ideal that posits that with the use of certain strategies, including environmental, community, interpersonal, or personal strategies, a person can reduce their experiences of negative consequences as a result of engaging in known behaviors with risky outcomes (Graham, Tatterson, Roberts, & Johnston, 2004; Marlatt, Somers, & Tapert, 1993; Marlatt & Witkiewitz, 2002; McBride, Farringdon, Midford, Meuleners, & Phillips, 2003; Single,

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1996). Health behavior consequences can be placed on a continuum of more serious and less serious consequences which coincide with substance use behaviors ranging from excessive use, moderation, and abstinence. Alcohol consumption and the negative consequences that result from personal alcohol use are applicable to this continuum (Marlatt et al., 1993). The Harm Reduction model posits that among users of alcohol, certain strategies can reduce the likelihood of experiencing serious negative consequences. These strategies can be achieved by the person, with such behaviors as limiting the amount of alcohol consumed or only drinking a certain type of alcohol (Benton et al., 2004; Delva et al., 2004; Marlatt & Witkiewitz, 2002).

The Harm Reduction model serves as the foundation of the limited literature on protective behavioral strategies (PBS) (Maratt & Witkiewitz, 2002). In some youth environments, including many college student social contexts, drinking is common and students may consciously or unconsciously adopt perceived behavioral expectations regarding drinking alcoholl(Fromme & Corbin, 2004). The idea of PBS posits that students can be taught that when they know they are going to be in a context where there is alcohol available, there are strategies that can be employed that will help them to avoid or limit their consumption and ultimately the negative consequences that may occur from consuming too much alcohol.

Previous measures of PBS have been reported. Benton et al. (2004) summed 10 PBS items into a single variable and found that women use PBS more frequently than males. Delva et al. (2004) identified the number, type, and frequency of PBS use among 1043 college students who disclosed recent drinking behavior. The most commonly used PBS were using a designated driver (74.6% female, 63.9% male), eating before or during drinking (74.3% female, 70.7% male), and keeping track of the number of drinks (65.4% female, 55.8% male). Martens et al. (2004) also used the American College Health Association–National College Health Assessment data to examine the moderating effect of PBS on negative consequences. The Martens et al. analysis was based on self-reported data gathered from undergraduate students ($n = 556$). The findings indicate that those using PBS were less likely to suffer negative consequences.

Two studies, published after this study's data collection, have examined the dimensionality, validity, and reliability of a PBS measure (Martens, Ferrier, & Cimini, 2007; Martens, Ferrier, Sheehy, Corbett, Anderson, & Simmons, 2005). These two studies provide preliminary support that a somewhat reliable and valid 3-factor (Stopping/Limiting Drinking, Manner of Drinking, and Serious Harm Reduction) PBS measure in a sample of undergraduate college student drinkers exists. However, subgroup differences were not explored in either of these two prior studies. Furthermore, this measure did not address several protective behavioral strategies that are included in this current study. Given the little research that has previously focused on development of a reliable and valid PBS measure and the insufficient research on subsample differences, such research is warranted. Prior research focusing on PBS has not examined sub-samples of the college population to identify differences among genders and races. While college campuses are traditionally comprised of a diverse student body, most research has focused on non-representative samples without regard to race. Furthermore, gender differences related to alcohol behaviors is widely known but not addressed in PBS psychometric testing. Because of these issues, it is important to not only create a valid and reliable PBS scale but to create a valid and reliable PBS scale that can be used across college student demographics.

Objectives of Current Study

While the use of PBS is an emerging intervention strategy, a standard PBS measure has not been developed. Such a measure is needed as a mechanism to evaluate PBS interventions and to better understand the relationship between alcohol use and negative consequences.

This study was conceptualized because of the gap in the literature regarding evidence of a generally accepted reliable and valid PBS measure, our own qualitative research suggesting that prior PBS lacked a variety of potential harm reduction strategies (Howard, Boekeloo, Griffin, Lake, & Bellows, 2007), and lack of prior research addressing subgroup differences. Therefore, this study aimed to:

1. compile a comprehensive list of PBS items;
2. further explore the dimensionality of the PBS items;
3. further explore the reliability of PBS items; and
4. examine the gender and racial differences of the PBS scale.

METHODS

Sample

This study was a sub-study of a larger National Institute on Alcohol Abuse and Alcoholism funded college alcohol problem prevention trial (Boekeloo, 2005) and was approved by the university's Institutional Review Board. The sampling and recruitment methods utilized in the larger study have been described in detail elsewhere (Boekeloo, Bush, & Novik, 2009; Boekeloo & Griffin, 2009; Boekeloo, Novik, Bush, & O'Grady, 2009; Howard, Griffin, & Boekeloo, 2008). Because the larger trial was focused on first-year freshmen, those students residing in predominantly freshman residence halls were recruited. Recruitment strategies included a personalized mailed letter, postcards, posters, and up to five personalized e-mails. Data were collected via a web-based survey targeting 1269 students (634 males, 635 females) 2 months into the fall semester. Of the targeted students, 538 students (221 males, 317 females) submitted complete data. Of those students, 320 students (131 males, 189 females) self-identified as drinkers based on their responses to four alcohol use items (alcohol of any type, beer, wine, liquor) and thus comprise the sample for this sub-study. This study's sample comprised of proportionately more females (59.1 %), first-time freshmen (92.5%), 18 year olds (75.0%), living-learning members (64.4%), and Whites (68.4%) (see Table 1).

Protective Behavioral Strategies Measure

Twenty-two items were included in two separate sections of the survey. To be as inclusive as possible and consistent with the Harm Reduction ideal, all items found in existing surveys (Benton et al., 2004; Delva et al., 2004; Martens et al., 2004) plus items developed for this study based on study-specific focus group findings (Howard et al., 2007) were included in the survey (Table 2). The Harm Reduction model, which is a secondary prevention ideal that posits with the use of certain strategies that call include environmental, community, interpersonal, or personal strategies, a person can reduce their experiences of negative consequences because of certain decisions or behaviors in which they engage (Graham et al., 2004; Marlatt et al., 1993; Marlatt & Witkiewitz, 2002; McBride et al., 2003). Because of the nature of potential protective efforts, all items identified as PBS that had previously been utilized in research were included. Additionally, items representing protective strategies that had not been included in previous studies that were identified and described by students from focus group discussions (Howard et al., 2007) for the parent study were also included in the survey. The first section of PBS items was included for only students who self-identified as drinkers (the sample for this study). Drinkers were asked to respond to 14 PBS items based on the lead-in statement "How often did you do the following since arriving (on campus) for the Fall 2006 semester?" These items were specific to alcohol-related behaviors (i.e., alternate non-alcoholic beverages and alcoholic beverages, determine not to exceed a set number of drinks, eat before and/or during drinking) and thus would have not been

relevant to non-drinkers. The second section of PBS items was completed by all survey respondents regardless of their recent drinking behaviors because those nine PBS items did not refer to alcohol-consumption behaviors (i.e., choose not to drink alcohol, drink an alcohol look-alike, hang out with trusted friends). The lead-in statement for these eight items was "Since arriving (on campus) for the Fall 2006 semester, when you socialized with others, how often did you:" The coded response options for all PBS items were 0 = never, 1 rarely, 2 = sometimes, 3 = usually, 4 always.

Demographic Measures

Key demographics included in this study were gender (male, female), race/ethnicity (white, non-white), and living-learning membership (belonging to a special university-sponsored group of students with similar academic interests who also reside together). The non-white category was created because the other racial categories, Asian, Black/African American, American Indian, or Native Hawaiian, had too small of sample sizes for meaningful analysis.

Analysis Plan

All data were analyzed utilizing SPSS 14.0. The dimensionality of the PBS scale was assessed via factor analysis whereas the gender and racial differences were assessed utilizing the Procrustes rotation method (Gorsuch, 1966; Schönemann & Carroll, 1970). The Procrustes rotation method allowed for direct comparison to be made between the two distinct samples (males and females, whites and non-whites) to identify similarities and differences between the samples and to identify the matrix of best fit for the factor structure across sub-samples. The Procrustes method also produced a coefficient of non-determination (CND) which represented how much of the variance of the matrix was not explained (Hair, Anderson, Tatham, & Black, 1998). While there is no established critical CND value, a desired CND value for this study was set at less than 0.20. After each factor analysis with Procrustes rotation, reliability analyses were performed for each resulting set of items. These processes (factor analysis with Procrustes rotation and reliability analyses) were repeated until an acceptable set of items resulted in adequate internal consistency across all samples. Internal consistency of the PBS scales was examined with inter-item correlations, descriptive statistics indicating variability for each item, item correlations with the total scale scores, as well as Cronbach's alpha coefficient with all items in the scale as well as the Cronbach's alpha coefficients after deleting each item separately from the scale.

RESULTS

Scale Development

All 22 PBS items in the survey were originally included in the analysis of the scale structure of the PBS measure (see Table 2). According to Hair et al. (1998), with a sample size of at least 250, a factor loading of 0.35 is acceptable based on an alpha level of 0.05 and a power level of 0.80. Because this was an exploratory factor analysis examining various sample differences, a factor loading of 0.35 was set as the inclusion level to retain a single variable as part of a factor. Through the examination of a series of factor analyses with Procrustes rotations to assess sub-sample similarities, it was determined that five items did not load well with the other items and did not result in reliable sub-scales. Those five items were subsequently deleted from the analyses. Factor analysis with Procrustes rotation was then repeated with the remaining 17 items. Upon re-examination of the factor and reliability analyses of these 17 items, two sub-scales (see Table 3) resulted that fit well for the total sample and for each sub-sample (gender, race). The two PBS sub-scales were then named based on the items that loaded more strongly on each sub-scale. "Limits" PBS was utilized for the nine items which dealt with behaviors associated with limiting alcohol consumption

prior to (via planning) or during consumption. For example, determining not to exceed a set number of drinks or keeping track of the number of drinks is a successful behavior to assure that alcohol limits are not exceeded. The factor loadings for these nine items ranged from 0.372 to 0.780. “Avoidance” PBS was utilized for the eight items that dealt with the manner in which students avoided alcohol altogether or avoided drinking too much alcohol while socializing or partying. For example, alternating non-alcoholic and alcoholic drinks and pacing the number of drinks per hour are behaviors to avoid drinking too much once the individual has already begun to consume alcohol. The factor loadings for these eight items ranged from 0.416 to 0.877. The CND among males and females was 0.1338 and 0.1397 among whites and non-whites indicating that there was a good fit across samples.

Reliability

In determining the best fit of the items with regard to scale dimensionality, reliability analyses were utilized. Among the total sample, the Limits PBS sub-scale had high internal consistency (Cronbach’s alpha 0.83) as did the Avoidance PBS sub-scale (Cronbach’s alpha 0.84). Furthermore, when examining sub-scale reliability for each of the sub-samples, both sub-scales produced high internal consistency as evidenced by Cronbach’s alpha coefficients of at least 0.81 for all sub-samples (see Table 4). Furthermore, the two PBS sub-scales exhibited moderate correlation with each other ($r = .586$, $p < .001$) suggesting convergent validity between the two sub-scales. This convergence suggests that these sub-scales are in fact dimensions of the same construct (protective behavioral strategies) rather than measures of two distinct and separate constructs.

DISCUSSION

The aims of this study were four-fold. First, a comprehensive list of PBS items was compiled. Items were borrowed from existing survey measures as well as those created based on focus group results for the parent study. This study also aimed to provide further evidence of the dimensionality and reliability of the PBS scale(s) in addition to examining sub-sample differences. The study findings indicate that the final PBS scale is bi-dimensional and reliable (as evidenced by high Cronbach alpha levels). The scale was developed via repeated factor analyses utilizing the Procrustes rotation method to account for sample differences between males and females as well as between whites and non-whites. Given the study sample was comprised of whites and minorities (see Table 1), it was important to assure that the final scale structure would fit across the sample. The comparison of different sub-samples is critical as the college demographics are diverse and due to differences in how alcohol behaviors manifest across demographics. The final PBS scale, after reliability and validity analysis, was shown to be bi-dimensional. The Limits PBS sub-scale was comprised of nine items which included behaviors students would engage in prior to or during drinking. The Avoidance PBS sub-scale was comprised of eight items that dealt with physical behaviors students would engage in during their partying or socializing experiences. Both sub-scales had high Cronbach’s alpha coefficients across all samples. The Avoidance PBS sub-scale was also moderately correlated to the Limits PBS sub-scale supporting validity of the overall PBS construct and suggesting that the final 17 PBS items can be used as a general indicator of protective strategies in addition to the use of the specific sub-scales. The moderate correlation between the two sub-scales suggests that the sub-scales are in fact two dimensions of the same construct (protective behaviors) rather than measures of two distinct constructs.

It is important to note that other variations of the dimensions would have been acceptable for the total sample and for some of the sub-samples. However, one critical aim of this study that had not been examined in prior research was to examine the gender and racial differences and to find a scale with appropriate sub-scales that would fit across all samples.

Therefore, the analyses were repeated until reliable measures were found across the total sample as well as the four different sub-samples. The two-factor solution was the best fitting structure across all samples with very high internal consistency.

After construction of the parent study survey (upon which this study's data were based), Martens et al. (2005) had further examined the dimensionality of a PBS scale. Factor analysis was utilized and resulted in a I5-item PBS scale with three related sub-scales. The three sub-scales were named Limiting/Stopping Drinking, Manner of Drinking, and Serious Harm Reduction. However, one sub-scale had an acceptable Cronbach's alpha coefficient, and two sub-scales had less than acceptable Cronbach's alpha coefficients. The alpha levels were .81, .73, and .63 respectively. Based on these preliminary fmdings, confirmatory factor analysis was conducted to further examine the psychometric properties of the three sub-scales and the overall PBS scale. The authors utilized 505 undergraduate students from two universities. A small percentage (27.5%) of the students was volunteers while the remaining participants were judicially mandated to perform some type of alcohol sanction. The authors determined through confirmatory factor analysis and maximum likelihood estimation procedures that a 3-factor PBS scale was supported. Additionally, all three sub-scales were related to each of the others, as well as were correlated in the expected direction with alcohol use and alcohol-related problems. However, the Cronbach's alpha coefficients were again rather low for two of the sub-scales. The alpha levels were .82, .74, and .59 respectively for the Stopping/Limiting Drinking, Manner of Drinking, and Serious Harm Reduction sub-scales (Martens et al., 2007).

While the Martens et al. studies (2005, 2007) provide additional dimensionality and reliability support for a PBS measure, the results from the current study are more favorable with regard to the reliability of the sub-scales specifically in the sample of predominantly freshmen students, and across gender and race sub-groups. Martens et al. (2005, 2007) reported only one sub-scale with high (Cronbach alpha of .80 or higher) internal consistency, whereas both of the sub-scales in the current study had high levels of internal consistency as reported by Cronbach alpha levels of .80 or higher, and this high internal consistency was maintained across all sub-samples (total sample, males, females, whites, and non-whites). It is noted that the current study did not target judicially mandated students as did the Martens et al. studies. While the individual sub-scales between this study and Martens et al. studies (2005, 2007) are not able to be directly compared, it does appear that the sub-scales reported in this study may be applicable across different samples of college freshmen students who have not previously been adjudicated for their alcohol use.

Limitations

There were a number of limitations associated with this study. First, the sampling frame utilized in the parent study was a purposive sample frame among predominantly freshmen residence hall residents, not a randomly selected sample of all students on the campus suggesting that there may be a sample bias. Second, the data collected was self-reported by college students. Therefore, the reliability of the survey data is dependent on the students' honesty and completeness of their responses. Furthermore, the "drinker" status utilized to identify this study sample was based on the students' self-reported alcohol use in the 30 days prior to survey completion. While multiple items were used to determine the "drinker" status for each student, some students may not have been included in this category that should have been and vice versa resulting in a dataset that did not reliably capture all college student drinkers. Therefore, the results of this study are only based on those students included in the final database, and this sample may be a biased sample of drinkers.

Third, the comparison between the white and non-white samples should be considered exploratory due to the decision to collapse all "non-white" students into a single category.

There may be additional racial influences not fully captured by treating all non-whites as one. Therefore, the lumping of all non-white students into a single category may pose bias and caution should be used when interpreting this category. Fourth, this study is based on cross-sectional data collected about 2 months into the fall academic semester at a large mid-Atlantic university. Therefore, time trends in college alcohol use are not considered as they relate to reliability and validity. Finally, the PBS items were asked of students in two different sections on the web-based survey. Those items which the researchers thought were directly associated with drinking alcohol were only asked of students who self-reported recent alcohol use. Students were directed to respond to those 14 items with the following lead-in statement, "How often did you do the following since arriving (on campus) for the Fall 2006 semester?" The remaining eight PBS items were asked of all students completing the web-based survey regardless of their current drinking status. A different lead-in statement was used for this section of PBS items and stated, "Since arriving (on campus) for the Fall 2006 semester, when you socialized with others, how often did you Δ ?" Because of the discrepancy between the lead-in statements and the absence of framing the last eight PBS items in the context of drinking environments, the students may have responded differently to the two sets of items. If the wording of the lead-in statements had been the same, the items may have loaded differently in the dimensionality analysis.

Recommendations for Future Research

Despite the limitations, this study addresses a gap in the current research by providing additional psychometric support for a PBS scale. With the results from this study as well as support provided by Martens et al. (2005, 2007), it is suggested that the PBS items begin to appear more frequently in research focusing on college student alcohol use. However, additional research focusing on various college student samples such as gender, race, grade status, and living situation, as well as voluntary and mandated samples is needed to generalize PBS measurements to all college students. Additionally, understanding of the social (special group membership such as Greek or Athlete) and environmental influences (for example the presence, location, and accessibility of bars) with respect to PBS is needed. Finally, because each of the PBS items are in fact behaviors, it is suggested that future studies also examine the relationships between the PBS scale and sub-scales with other psychosocial predictors of alcohol-related behavior, thus providing further support for the construct validity of the PBS scale. By gaining a better understanding of the complex relationships between psychosocial predictors, PBS, and alcohol outcomes, researchers will be armed with more specific strategies to address the issue of college student alcohol use.

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Table 1

Characteristics of Drinkers vs. Non-Drinkers

	Non-Drinkers	Drinkers	χ^2 (*p*-value)
Gender			
Male	90 (41.3%)	131 (40.9%)	.01 (.936)
Female	128 (58.7%)	189 (59.1%)	
First-time freshman			
Yes	200 (91.7%)	296 (92.5%)	.10 (.748)
No	18 (8.3%)	24 (7.5%)	
Age			
17	21 (9.6%)	35 (10.9%)	2.32 (.313)
18	175 (80.3%)	240 (75.0%)	
19+	22 (10.1%)	45 (14.1%)	
Living-Learning member			
Yes	151 (69.3%)	206 (64.4%)	1.39 (.238)
No	67 (30.7%)	114 (35.6%)	
Race			
White	103 (47.2%)	219 (68.4%	24.22 (< .001)
Non-White	115 (52.8%)	1 01 (31 .6%)	
Study condition			
Control	66 (30.3%)	129 (40.3%)	5.77 (.056)
Single gender	8O (36.7%)	104 (32.5%)	
Mixed gender	72 (33.0%)	87 (27.2%)	

Table 2

Compilation of Existing and New PBS Survey Items

PBS Item	PAF, 2005	Delva et al., 2004; Martens et al., 2004	Benton et al., 2004	Martens et al., 2005[a]
[b]Alternate non-alcoholic beverages and alcoholic beverages	X	X	X	XX
[b]Determine, in advance, not to exceed a set number of drinks	X	X	X	X
[b]Eat before and/or during drinking	X	X		
[b]Have a friend let you know you'd had enough	X	X	X	
[b]Keep track of how many drinks you were having	X	X	X	
[b]pace your drinks to 1 or fewer per hour	X	X	X	X
[b]Avoid drinking games	X	X		X
[b]Stop drinking at least 1-2 hours before going home	X		X	X
[b]Limit money spent on alcohol	X		X	
[b]Only drink in safe environments	X		X	
[b]Make your own drinks	X		X	
[b]Avoid hard liquor or spirits	X			X
[b]Refuse a drink from a stranger	X			
[b]Never leave a drink unattended	X			X
Choose not to drink alcohol	X	X		
Use a designated driver	X	X	X	X
[b]Drink an alcohol look-alike (non-alcoholic beer, etc.)	X	X		
Hang out with trusted friends	X		X	X
Participate in activities that did not include alcohol	X			
[b]Carry around a cup but not drink any alcohol	X			
Use public transportation services	X			
[b]Avoid situations where there was alcohol	X			
Leave the bar/party at a predetermined time				X
Put extra ice in your drink				X

[a]These items not available at time of original survey creation.

[b]These items represent the 17 items comprising the final scale and sub-scales.

Table 3

Factor Structure: PBS Rotated Factor Loadings[a]

	Promax Rotated Factor Loadings	
PBS Items	**Limits**	**Avoidance**
Alternate non-alcoholic beverages and alcohol beverages	.364	**.416**
Determine, in advance, not to exceed a set number of drinks	**.579**	.260
Eat before and/or during drinking	**.780**	−.152
Have a friend let you know when you've had enough	**.372**	.202
Keep track of how many drinks you were having	**.756**	−.030
Pace your drinks to 1 or fewer per hour	.333	**.603**
Avoid drinking games	.237	**.596**
Stop drinking at least 1-2 hours before going home	.249	**.565**
Limit money spent on alcohol	**.530**	.242
Only drink in safe environments	**.760**	−.106
Make your own drinks	**.623**	−.143
Avoid hard liquor or spirits	.230	**.459**
Refused a drink from a stranger	**.637**	.049
Never left a drink unattended	**.714**	−.206
Drink an alcohol look-alike	−.332	**.827**
Carry around a cup but did not drink any alcohol	−.197	**.820**
Avoid situations where there was alcohol	−.230	**.877**

[a]**Bolded** factor loadings represent items loading on specified PBS sub-scale.

Table 4

Cronbach's Alpha Coefficient for All Sub-Samples

Sample	Limits	Avoidance
Total (n = 320)	.830	.844
Males (n = 131)	.816	.809
Females (n = 189)	.839	.861
Whites (n = 219)	.806	.838
Non-whites (n = 101)	.869	.838