Does the How Mediate the Why? A Multiple Replication Examination of Drinking Motives, Alcohol Protective Behavioral Strategies, and Alcohol Outcomes

ADRIAN J. BRAVO, M.S.,^{a,*} MARK A. PRINCE, PH.D.,^b & MATTHEW R. PEARSON, PH.D.^c

^a*Department of Psychology, Old Dominion University, Norfolk, Virginia*

^b*Research Institute on Addictions, University at Buffalo, The State University of New York, Buffalo, New York*

^c*Center on Alcoholism, Substance Abuse, and Addictions, University of New Mexico, Albuquerque, New Mexico*

ABSTRACT. Objective: The present study attempted to assess the evidence of use of protective behavioral strategies (PBS) as a mediator in the relationship between drinking motives and alcohol outcomes. Specifically, to understand various statistical approaches in modeling this proposed mediation model (e.g., drinking motives to PBS use to alcohol outcomes), we tried to replicate models based on earlier research. **Method:** To maximize the robustness of our replication attempts, we conducted each replication attempt across two distinct data sets whenever possible. Participants were recruited from psychology department research pools at a large southeastern U.S. university (Sample 1; $n = 774$) and a large southwestern U.S. university (Sample 2; $n = 594$). We matched the original articles' analytic procedures as closely as possible

including overall analysis approach, measurement of variables, and inclusion/exclusion criteria. **Results:** Consistent with previous studies, we found that PBS use may be a mechanism through which both positively reinforcing (i.e., social and enhancement) motives and coping motives relate to alcohol outcomes (e.g., alcohol-related consequences). Specifically, students who tend to drink for these specific motives appear to use fewer PBS, which may place them at risk for heavier, more problematic drinking. **Conclusions:** Our results suggest that when drinking motives are examined separately, they demonstrate differential relationships with PBS use and alcohol outcomes. Overall, it is clear that PBS use plays a role in the drinking motives–alcohol outcomes relationship, but this role varies by type of motive. (*J. Stud. Alcohol Drugs*, 76, 872–883, 2015)

THE NATIONAL INSTITUTE on Alcohol Abuse and Alcoholism (NIAAA; 2015) has recognized alcohol misuse as the most important health hazard for college students because of the high rates of heavy drinking, negative alcohol-related consequences (ARC), and prevalence of alcohol use disorders. Motivation models of alcohol use (Cooper, 1994; Cox & Klinger, 1988) posit that drinking motives are the most proximal antecedent to alcohol use involvement (i.e., the decision to drink), and different drinking motives are associated with different patterns of alcohol consumption. Based on the Cox–Klinger model, drinking motives are defined by two primary dimensions: source of motivation (internal vs. external) and type of reinforcement (positive vs. negative).

Internal, or mood-related, motives include positively reinforcing motives (i.e., to enhance one's mood: enhancement) and negatively reinforcing motives (i.e., to reduce one's negative mood: coping). External motives include positively reinforcing motives (i.e., to improve social interactions: social) and negatively reinforcing motives (i.e., to

avoid negative social interactions or avoid peer disapproval: conformity).

Based on multivariate analyses across scores of studies, it seems that internal motives (i.e., enhancement and coping) are most strongly related to alcohol use, and negatively reinforcing motives (i.e., coping and conformity) are most directly related to ARC (Ham & Hope, 2003; Kuntsche et al., 2005). Whereas enhancement motives tend to have a significant indirect effect on ARC via increased alcohol use, social motives are generally only modestly related to alcohol use and not strongly related to ARC. Although exceptions can be found, the most consistent relationship is that coping motives are directly related to ARC even when alcohol use and numerous other putative antecedents to alcohol use involvement including personality traits, emotional functioning, and other individual difference variables are controlled for (Ham & Hope, 2003; Kuntsche et al., 2005). Given the strength of these associations, it is imperative to understand more manipulable factors that can explain these associations.

Protective behavioral strategies (PBS) are “behaviors used immediately prior to, during, and/or after drinking that reduce alcohol use, intoxication, and/or alcohol-related harm” (Pearson, 2013, p. 1030). Reviews have demonstrated that PBS use is robustly negatively associated with a range of alcohol outcomes including alcohol use and ARC (Pearson, 2013; Prince et al., 2013). PBS use has also been examined as a mediator of the association between a wide range of variables and alcohol outcomes including impulsivity-like

Received: April 23, 2015. Revision: June 8, 2015.

Matthew R. Pearson is supported by National Institute on Alcohol Abuse and Alcoholism (NIAAA) Career Development Grant K01-AA023233. Mark A. Prince is supported by NIAAA Training Grant T32-AA007583.

*Correspondence may be sent to Adrian J. Bravo at the Department of Psychology, Old Dominion University, 250 Mills Godwin Building, Norfolk, VA 23529-0267, or via email at: abravo@odu.edu.

traits (Pearson et al., 2012b), conscientiousness (Martens et al., 2009), age at first alcohol use (Palmer et al., 2010), self-regulation (D'Lima et al., 2012), and depressive symptoms (Martens et al., 2008).

Multiple researchers have examined whether PBS use mediates drinking motives–alcohol outcome associations. Although researchers have found support for PBS use mediating drinking motive–alcohol outcome associations (Ebersole et al., 2012; LaBrie et al., 2011; Martens et al., 2007a), the statistical and measurement approaches of each of these studies have varied. For example, LaBrie et al. (2011) examined a single latent factor of PBS use as a mediator of the association between a latent factor of drinking motives and a latent factor of alcohol outcomes. Ebersole et al. (2012) and Martens et al. (2007a) examined a single composite score and a single latent factor of PBS use, respectively, as a mediator of the associations between distinct drinking motives and alcohol outcomes.

The purpose of our study was to extend research on the associations among drinking motives, PBS use, and alcohol outcomes. We attempted to replicate previous research that has indicated that PBS use statistically mediates drinking motives–alcohol outcomes associations. Given its malleability and proximity to drinking occasions, PBS use may help to explain how drinking motives relate to alcohol outcomes. Moreover, to understand various statistical approaches in modeling this proposed mediation model (drinking motives → PBS use → alcohol outcomes), we attempted to replicate models based on LaBrie et al. (2011), Martens et al. (2007a), and Ebersole et al. (2012). These distinct models differed in whether latent variables or composite measures were used, whether specific facets of drinking motives were examined in a single model or separate models, and what alcohol outcomes were examined.

As the field has not come to a consensus regarding how these associations should be modeled, we aimed to examine these distinct modeling strategies using multiple independent samples. We followed the statistical procedures reported by the original authors and compared the models in terms of replicability and conceptual clarity.

Method

Participants and procedure

To maximize the robustness of our replication attempts, we conducted each replication attempt across two distinct data sets whenever possible. Participants were recruited from psychology department research pools at a large southeastern U.S. university (Sample 1; $n = 774$) and a large southwestern U.S. university (Sample 2; $n = 594$). Demographics are described in Table 1. Both studies were approved by an institutional review board, and students received research participation credits for participating.

Measures

Alcohol consumption. Alcohol consumption was measured with a modified version of the Daily Drinking Questionnaire (Collins et al., 1985). Participants indicated how much (and for how long in Sample 2) they drank during a typical week in the past 30 days using a 7-day grid from Monday to Sunday. We summed numbers of standard drinks consumed on each day of the typical drinking week.

Alcohol-related consequences. ARC were assessed using a checklist version of the Brief Young Adult Alcohol Consequences Questionnaire (B-YAACQ; Kahler et al., 2005), where participants checked a box for each ARC that they experienced in the past month (e.g., “While drinking, I have said or done embarrassing things,” “I have felt badly about myself because of my drinking”). We summed items to create a measure reflective of the number of distinct ARC experienced in the past 30 days. Because of experimenter error in Sample 2, two items were given as one item, resulting in a 23-item version of the measure. Data were analyzed including/excluding this compound item, and no differences were found in the pattern of results.

Protective behavioral strategies. Past-month PBS use was assessed with the 15-item Protective Behavioral Strategies Survey (PBSS; Martens et al., 2005) measured on a 6-point response scale (*never, rarely, occasionally, sometimes, usually, and always*). We changed a previously reverse-coded item (“drink shots of liquor”) to be consistent with the remaining items (“avoid drinking shots of liquor”). Three subscales identified in previous work include Limiting/Stopping Drinking (7 items), Manner of Drinking (5 items), and Serious Harm Reduction (3 items). Alphas ranged from .76 to .89 across subscales and samples.

Drinking motives. Drinking motives were assessed using the 20-item Drinking Motives Questionnaire–Revised (DMQ-R; Cooper, 1994) in Sample 1, which assesses four reasons for drinking (social, conformity, enhancement, and coping), and the 28-item Modified Drinking Motives Questionnaire–Revised (M-DMQ-R; Grant et al., 2007) in Sample 2, which splits the original coping motives facet into coping with anxiety and coping with depression (i.e., five facets instead of four facets). Consistent with Grant et al.’s recommendations, we used the social subscale from the DMQ-R (Cooper, 1994). For both measures, respondents used a 5-point response scale (1 = *never/almost never*, 5 = *almost always/always*). Alphas ranged from .79 to .95 across subscales and samples.

Replication attempt 1

In a sample of 1,592 heavy drinking college students from two universities, LaBrie et al. (2011) examined the extent to which PBS use mediated the associations between drinking motives and alcohol consumption. Within their structural

TABLE 1. Demographics of original samples

Variable	Sample 1 n (%)	Sample 2 n (%)
Gender		
Male	220 (28.4)	212 (35.7)
Female	548 (70.8)	380 (64.0)
Missing	6 (0.8)	2 (0.3)
Age, in years		
<i>M (SD)</i>	22.00 (6.35)	20.07 (3.63)
18	168 (21.7)	209 (35.2)
19	166 (21.4)	138 (23.2)
20	110 (14.2)	87 (14.6)
≥21	316 (40.8)	154 (26.0)
Missing	14 (1.8)	6 (1.0)
Race/ethnicity		
American Indian/Alaska Native	4 (0.5)	9 (1.5)
Asian	32 (4.1)	20 (3.3)
Black/African American	180 (23.3)	9 (1.5)
Native Hawaiian/Pacific Islander	4 (0.5)	2 (0.3)
White, non-Hispanic White	323 (41.7)	193 (32.5)
Other	16 (2.1)	6 (1.0)
Hispanic/Latino	15 (1.9)	327 (55.1)
Mixed	200 (25.8)	28 (4.7)
Education		
Freshman	258 (33.3)	263 (44.3)
Sophomore	160 (20.7)	133 (22.4)
Junior	167 (21.6)	97 (16.3)
Senior	179 (23.1)	97 (16.3)
Graduate student	4 (0.5)	3 (0.5)
Missing	6 (0.8)	1 (0.2)

Notes: Race/ethnicity was assessed with a single radio button item (i.e., limited to one selection) for Sample 1; race and ethnicity were assessed with separate checkbox items (i.e., could select multiple options) in Sample 2.

equation model (SEM), drinking motives were modeled as a latent variable with four drinking motives (i.e., social, coping, enhancement, and conformity) as manifest indicators; PBS use was modeled as a latent variable with the three PBSS subscales as manifest indicators; and alcohol consumption was modeled as a latent variable with drinks per week, hours per week drinking, and days per month drinking as manifest indicators.

The researchers found that PBS partially mediated the association between drinking motives and alcohol consumption, such that higher drinking motives predicted lower PBS use and lower PBS use predicted higher alcohol consumption. Invariance analyses across subsamples of gender and race revealed that PBS use largely mediated the relationship between drinking motives and alcohol consumption in all demographic subsamples.

Statistical analyses

Given that Sample 2 was the only data set that assessed hours per week drinking, we were only able to attempt to replicate findings from LaBrie et al. (2011) in this sample. Consistent with the exclusionary criteria from the LaBrie et al. study, our analytic sample included only individuals who reported engaging in at least one heavy drinking episode (e.g., four/five or more drinks for females/males in a

2-hour period) in the previous month ($N = 401$). We assessed “days per month” drinking using one open-ended item asking, “How many days did you drink alcohol during the past month?” whereas LaBrie and colleagues used one item on a 7-point response scale (0 = *I do not drink at all*, 2 = *twice a week*, 4 = *four times a week*, 7 = *every day*), “How many days of the week did you drink alcohol during the past month?” Whereas they used the four-facet DMQ-R (Cooper, 1994) to assess drinking motives, we used the five-facet M-DMQ-R (Grant et al., 2007). Last, we measured PBS use on a 6-point response scale, as compared with their 5-point response scale.

To evaluate overall model fit, we used model fit criteria suggested by Hu and Bentler (1999) including the comparative fit index (CFI) > .95, Tucker–Lewis Index (TLI) > .95, root mean square error of approximation (RMSEA) < .06, and standardized root mean square residual (SRMR) < .08. We examined the total, direct, and indirect effects of each predictor variable on outcomes using bias-corrected bootstrapped estimates (Efron & Tibshirani, 1993) based on 10,000 bootstrapped samples, which provides a powerful test of mediation (Fritz & MacKinnon, 2007) and is robust to small departures from normality (Erceg-Hurn & Mirosevich, 2008).

Parameters were estimated using maximum likelihood estimation, and missing data were handled using full information maximum likelihood, which is more efficient and has less bias than alternative procedures (Enders, 2001; Enders & Bandalos, 2001). Statistical significance was determined by 95% bias-corrected bootstrapped confidence intervals that do not contain zero.

We examined bivariate correlations among all study variables as a function of gender (consistent with LaBrie et al., 2011) and implemented SEM using Mplus 7 (Muthén & Muthén, 1998–2012) to test the mediation model. We combined the items of coping with depression and anxiety motives together to create a single coping motives variable, and the error terms of coping and conformity motives were allowed to covary. We standardized the drinking measures before entry into the model.

Results: Replication Attempt 1

In the full sample, the bivariate relationships between drinking motives and alcohol consumption variables were identical in direction and similar in strength to the results reported by LaBrie et al. (2011). For females, the bivariate relationships between PBSS subscales and alcohol consumption variables were identical in direction and similar in strength to the results reported by LaBrie et al.; however, among males none of the PBSS subscales were significantly correlated with alcohol consumption variables except drinks per week. Further, compared with LaBrie et al., we found a pattern of inconsistent correlations between drinking motives

FIGURE 1. The replicated estimated structural equation model of LaBrie et al. (2011) in Sample 2. MOD = manner of drinking; S/LD = stopping/limiting drinking; SHR = serious harm reduction; PBS = protective behavioral strategies. Standardized values are presented.

* $p < .05$; *** $p < .001$.

and PBSS subscales across gender, and the strengths of our correlations were much weaker. Supplementary tables of all correlations, Cronbach's alphas, and descriptive statistics for each replication attempt are available from the authors on request.

The SEM model provided poor fit according to some indices, $\chi^2(32) = 135.584$, $p < .001$, TLI = .864, RMSEA = .090 (90% CI [.075, .106]), and acceptable fit on other indices, CFI = .903, SRMR = .058. Direct effects of the replicated mediation model are presented in Figure 1. Consistent with LaBrie et al. (2011), higher drinking motives were associated with higher levels of alcohol consumption ($\beta = .24$, 95% CI [.12, .35]) and lower levels of PBS use ($\beta = -.23$, 95% CI [-.36, .10]), and PBS use was significantly negatively associated with alcohol consumption ($\beta = -.17$, 95% CI [-.31, -.04]). Surprisingly, the indirect effect of drinking motives on alcohol consumption via PBS use was not statistically significant (indirect $\beta = .04$, 95% CI [-.00, .08]).

Discussion: Replication Attempt 1

All associations between drinking motives, PBS use, and alcohol consumption were in the same direction in the present study as reported by LaBrie et al. (2011). Although there was consistency in mean scores for both studies and we replicated the direct effects found by LaBrie et al., the mediated effect was not statistically significant (i.e., drink-

ing motives $\rightarrow$ PBS use $\rightarrow$ alcohol consumption). We did not use the exact same measures as used in the original study, and our analytic sample size ($N = 401$) was about a third of the sample size of the LaBrie et al. study ($N = 1,592$), resulting in substantially less statistical power to detect the mediation effect. Our results could suggest that other ways of modeling this mediation may be more robust to replication.

Replication attempt 2

In a sample of 254 drinking college students, Martens et al. (2007a) examined the extent to which PBS use mediated the associations between three types of drinking motives (i.e., social, enhancement, and coping motives) and alcohol consumption (measured by drinks per week) and ARC. Within their two SEM models, the three drinking motives were modeled as exogenous manifest variables, PBS use was modeled as a latent variable with the three PBSS subscales as manifest indicators, and both alcohol consumption and ARC were modeled as manifest (or composite) variables and examined in separate models.

The researchers found that PBS use partially mediated the associations between both social and enhancement motives and both alcohol outcomes, such that higher drinking motives predicted lower PBS use and lower PBS use predicted higher alcohol outcomes. However, PBS use did not signifi-

TABLE 2. Summary of total, indirect, and direct effects of Martens et al. (2007a) replication

Replication data sets	Sample 1		Sample 2*	
	β	[95% CI]	β	[95% CI]
Outcome variable: Alcohol consumption				
Predictor variable: Social motives				
Total	-.010	[-.111, .091]	.123	[.013, .232]
Total indirect (PBS)	.042	[.008, .076]	-.001	[-.024, .023]
Direct	-.052	[-.153, .049]	.124	[.013, .234]
Predictor variable: Enhancement motives				
Total	.293	[.179, .406]	.194	[.102, .287]
Total indirect (PBS)	.047	[.012, .083]	.053	[.013, .093]
Direct	.246	[.134, .357]	.141	[.045, .238]
Predictor variable: Coping motives				
Total	.181	[.057, .304]	.064	[-.026, .155]
Total indirect (PBS)	.014	[-.011, .040]	-.010	[-.027, .008]
Direct	.166	[.046, .286]	.074	[-.015, .163]
Outcome variable: Alcohol-related consequences				
Predictor variable: Social motives				
Total	.101	[-.001, .204]	.208	[.113, .303]
Total indirect (PBS)	.051	[.011, .092]	-.001	[-.038, .036]
Direct	.050	[-.050, .151]	.209	[.113, .304]
Predictor variable: Enhancement motives				
Total	.109	[.001, .217]	.169	[.066, .272]
Total indirect (PBS)	.058	[.015, .101]	.090	[.040, .140]
Direct	.051	[-.054, .156]	.079	[-.030, .188]
Predictor variable: Coping motives				
Total	.272	[.169, .375]	.278	[.192, .363]
Total indirect (PBS)	.018	[-.012, .048]	-.016	[-.042, .010]
Direct	.253	[.159, .348]	.294	[.210, .377]

Notes: CI = confidence interval; PBS = protective behavioral strategies. Significant effects are in **bold** for emphasis and were determined by a 95% bias-corrected bootstrapped CI (based on 10,000 bootstrapped samples) that does not contain zero. *Sample 2 used the five-factor version of the Modified Drinking Motives Questionnaire-Revised, and thus "drink to cope" values were calculated by combining both coping with anxiety and depression items.

cantly mediate the associations between coping motives and alcohol outcomes.

Statistical analyses

We attempted to replicate Martens et al.'s (2007a) findings across two data sets. Consistent with the exclusionary criteria from the Martens et al. study, our analytic samples included only college students who reported drinking at least one time in the past 30 days: Sample 1 ($n = 539$) and Sample 2 ($n = 563$). It is important to note small measurement differences between these studies.

First, we used the B-YAACQ (Kahler et al., 2005) in both data sets to assess ARC, whereas they used the Rutgers Alcohol Problem Index (RAPI; White & Labouvie, 1989). Further, whereas they used the Drinking Motives Questionnaire (Cooper et al., 1992) to assess drinking motives, we used the DMQ-R (Cooper, 1994) in Sample 1 and the M-DMQ-R (Grant et al., 2007) in Sample 2. Although the M-DMQ-R splits coping motives into depression and anxiety facets, to be more consistent with Martens et al., we created a single coping motives composite score.

Consistent with Martens et al. (2007a), we conducted bivariate correlations to examine the associations among

social motives, enhancement motives, coping motives, PBS use, alcohol consumption (measured as typical drinks per week), and ARC across both data sets. We used SEM (Mplus 7; Muthén & Muthén, 1998–2012) to test the two proposed mediation models: (a) three drinking motives $\rightarrow$ PBS use latent variable $\rightarrow$ alcohol consumption and (b) three drinking motives $\rightarrow$ PBS use latent variables $\rightarrow$ ARC. For identification purposes, the path from the latent PBS variable to the stopping/limiting drinking indicator was set to 1, and the drinking motives were allowed to correlate in all models.

Results: Replication Attempt 2

Across both data sets, all three drinking motives were positively correlated with alcohol consumption and ARC. PBSS subscales were negatively correlated with both alcohol consumption and ARC. The only discrepancy came with regard to the correlations between drinking motives and PBSS subscales. In Sample 1, all three drinking motives were negatively correlated with the PBSS subscales, whereas in Sample 2, social and enhancement motives were negatively correlated with limiting/stopping drinking and manner of drinking, and coping motives were negatively correlated with serious harm reduction.

FIGURE 2. The replicated estimated structural equation models of Martens et al. (2007a) in Sample 1. Standardized values are presented. Error terms, correlations among exogenous variables, and Protective Behavioral Strategies Survey (PBSS) indicators are not included for reasons of parsimony but are available on request.

** $p < .01$; *** $p < .001$.

Model 1 (alcohol consumption)

The SEM model in Sample 1 provided acceptable to good fit to the data based on most fit indices, CFI = .960, TLI = .919, RMSEA = .077 (90% CI [.053, .103]), SRMR = .034. Although the significant Model chi-square would suggest poor model fit, $\chi^2(9) = 37.89$, $p < .001$, the Model chi-square is highly sensitive to sample size (Jöreskog & Sörbom, 1993; Kline, 1998). The SEM model in Sample 2 provided poorer fit to the data based on all fit indices, Model $\chi^2(9) = 58.03$, $p < .001$, CFI = .893, TLI = .787, RMSEA = .098 (90% CI [.075, .123]), SRMR = .044. The total, total indirect, and direct effects for both data sets are summarized in Table 2, and direct paths are depicted in Figures 2 (Sample 1) and 3 (Sample 2).

Consistent with Martens et al. (2007a), PBS use partially

mediated the relationship between enhancement motives and alcohol consumption in Sample 1 (indirect $\beta = .05$, 95% CI [.01, .08]) and Sample 2 (indirect $\beta = .05$, 95% CI [.01, .09]). PBS use also partially mediated the relationship between social motives and alcohol consumption in Sample 1 (indirect $\beta = .04$, 95% CI [.01, .08]). PBS use did not significantly mediate the association between coping motives and alcohol consumption across both data sets.

Model 2 (alcohol-related consequences)

The SEM model in Sample 1 provided good fit to the data based on most fit indices, $\chi^2(9) = 39.30$, $p < .001$, CFI = .959, TLI = .917, RMSEA = .079 (90% CI [.055, .105]), SRMR = .033. The SEM model in Sample 2 provided poorer fit to the data based on all fit indices, $\chi^2(9) = 64.18$,

FIGURE 3. The replicated estimated structural equation models of Martens et al. (2007a) in Sample 2. Standardized values are presented. Error terms, correlations among exogenous variables, and Protective Behavioral Strategies Survey (PBSS) indicators are not included for reasons of parsimony but are available on request.

* $p < .05$; ** $p < .01$; *** $p < .001$.

$p < .001$, CFI = .912, TLI = .824, RMSEA = .104 (90% CI [.081, .129]), SRMR = .046. Consistent with Martens et al. (2007a), PBS use partially mediated the relationship between enhancement motives and ARC in Sample 1 (indirect $\beta = .06$, 95% CI [.02, .10]) and Sample 2 (indirect $\beta = .09$, 95% CI [.04, .14]). PBS use partially mediated the relationship between social motives and ARC in Sample 1 (indirect $\beta = .05$, 95% CI [.01, .09]), but PBS use did not significantly mediate the association between coping motives and ARC across both data sets (Table 2).

Discussion: Replication Attempt 2

In two independent samples, we were able to replicate most effects observed and reported by Martens et al.

(2007a). Specifically, we found support for PBS use to partially mediate the relationship between enhancement motives and alcohol outcomes (i.e., alcohol consumption and ARC) across both studies, and the relationship between social motives and alcohol outcomes in one study. Neither study found support for PBS use to mediate the relationship between coping motives and alcohol outcomes. Taken together, we have support for PBS use playing a role in the relationship between positively reinforcing motives and alcohol outcomes, but little evidence for PBS use as a mediator of the negatively reinforcing motives–alcohol outcomes relationship. These findings suggest students who tend to drink to enhance their mood and improve their social interactions appear to use fewer PBS, which may place them at risk for heavier, more problematic drinking.

TABLE 3. Summary of total, indirect, and direct effects of Ebersole et al. (2012) replication

Replication data sets	Sample 1		Sample 2*	
	β	[95% CI]	β	[95% CI]
Outcome variable: Alcohol-related consequences				
Predictor variable: Social motives				
Total	.302	 [.217, .388]	.420	 [.346, .493]
Total indirect (PBS)	.065	 [.032, .099]	.050	 [.021, .078]
Direct	.237	 [.147, .326]	.370	 [.293, .447]
Predictor variable: Enhancement motives				
Total	.315	 [.230, .400]	.469	 [.402, .535]
Total indirect (PBS)	.073	 [.038, .109]	.058	 [.028, .087]
Direct	.242	 [.150, .334]	.411	 [.336, .486]
Predictor variable: Coping with anxiety motives				
Total	—	—	.433	 [.361, .505]
Total indirect (PBS)	—	—	.033	 [.007, .059]
Direct	—	—	.400	 [.327, .472]
Predictor variable: Coping with depression motives				
Total	.383	 [.295, .471]	.413	 [.335, .491]
Total indirect (PBS)	.056	 [.028, .085]	.032	 [.009, .056]
Direct	.327	 [.239, .415]	.381	 [.301, .460]
Predictor variable: Conformity motives				
Total	.302	 [.201, .404]	.289	 [.200, .378]
Total indirect (PBS)	.022	[-.005, .049]	.010	[-.013, .033]
Direct	.280	 [.185, .375]	.279	 [.191, .367]

Notes: CI = confidence interval; PBS = protective behavioral strategies. Significant effects are in **bold** for emphasis and were determined by a 95% bias-corrected bootstrapped CI (based on 10,000 bootstrapped samples) that does not contain zero. *Sample 1 used the four-factor version of the Drinking Motives Questionnaire-Revised and thus “drink to cope” values are entered as coping with depression motives.

Replication attempt 3

In a sample of 143 lesbian, gay, bisexual, and transgender (LGBT) college students, Ebersole et al. (2012) examined the extent to which PBS use mediated the influence of five specific drinking motives on ARC. All variables were modeled as manifest variables. In separate models for each drinking motive, the researchers found that PBS significantly mediated the pathways between enhancement motives and ARC as well as coping with depression motives and ARC, such that higher drinking motives predicted lower PBS use and lower PBS use predicted higher ARC. However, these effects were not found with the three other drinking motives.

Statistical analyses

Consistent with the exclusionary criteria from Ebersole et al. (2012), our analytic sample included only traditional-age (18- to 25-year-old) college students who reported drinking at least one time in the past 30 days: Sample 1 ($n = 449$) and Sample 2 ($n = 594$). The most notable difference is that Ebersole et al. focused on LGBT college students, whereas we examined the mediation models in college students irrespective of sexual orientation. We used the B-YAACQ (Kahler et al., 2005) in both data sets to assess ARC, whereas they used the RAPI (White & Labouvie, 1989). Further, in Sample 1, we used the four-facet DMQ-R (Cooper, 1994) instead of the five-facet M-DMQ-R (Grant et al., 2007) and, thus, were unable to distinguish coping with depression from coping with

anxiety motives. We summed all items to create a total score for each variable of interest, examined bivariate correlations among all study variables, and tested the five proposed mediation models (four for Sample 1) using Mplus 7 (Muthén & Muthén, 1998–2012) across both data sets.

Results: Replication Attempt 3

Across both data sets, each drinking motive was positively correlated with ARC, each drinking motive (except conformity) was negatively associated with PBS use, and PBS use was negatively correlated with ARC. The total, total indirect, and direct effects are summarized in Table 3, and direct paths are shown in Figures 4 (Sample 1) and 5 (Sample 2). Consistent with Ebersole et al. (2012), PBS use partially mediated the relationship between coping with depression motives and ARC in Sample 2 (indirect $\beta = .03$, 95% CI [.01, .06]); the relationship between enhancement motives and ARC in Sample 1 (indirect $\beta = .07$, 95% CI [.04, .11]) and Sample 2 (indirect $\beta = .06$, 95% CI [.03, .09]); but not the association between conformity motives and ARC in either data set.

In Sample 1, PBS use partially mediated the relationship between overall coping motives and ARC (indirect $\beta = .06$, 95% CI [.03, .09]). We also found significant effects that were not found by Ebersole et al.: PBS use partially mediated the relationship between social motives and ARC in Sample 1 (indirect $\beta = .07$, 95% CI [.03, .10]) and Sample 2 (indirect $\beta = .05$, 95% CI [.02, .08]), and PBS use partially mediated

FIGURE 4. The replicated mediation models of Ebersole et al. (2012) in Sample 1. Standardized values are presented. $***p < .001$.

the relationship between coping with anxiety motives and ARC in Sample 2 (indirect $\beta = .03$, 95% CI [.01, .06]).

Discussion: Replication Attempt 3

In two independent samples, we were able to replicate most effects observed and reported by Ebersole et al. (2012). Specifically, (a) PBS use significantly mediated the associations between coping motives and ARC (overall coping motives in Sample 1, coping with depression in Sample 2), (b) PBS use significantly mediated the associations between enhancement motives and ARC (across both data sets), and (c) PBS use did not mediate the relationships between conformity motives and ARC (across both data sets). In addition, we found that PBS use significantly mediated the associations between social motives and ARC (across both

data sets) and coping with anxiety and ARC (Sample 2), which was not found by Ebersole et al.

Consistent with Martens et al. (2007a), our results suggest that PBS use may be a mechanism through which both positively reinforcing (i.e., social and enhancement) motives relate to alcohol outcomes. In addition, we found that PBS use may be a mechanism through which coping motives—both overall coping motives as well as coping with depression and coping with anxiety motives specifically—relate to ARC. Specifically, students who tend to drink for these specific motives appear to use fewer PBS, which may place them at risk for more problematic drinking.

There are several potential explanations for these discrepant findings. Ebersole et al. (2012) targeted LGBT individuals specifically, whereas we examined college students irrespective of sexual orientation. It is possible that sexual

FIGURE 5. The replicated mediation models of Ebersole et al. (2012) in Sample 2. Standardized values are presented.
 ** $p < .01$; *** $p < .001$.

orientation moderates these indirect effects; however, we are unable to test this possibility directly. Because we had a substantially larger sample size, we may have detected these additional indirect effects given our higher statistical power. In the literature, there is inconsistent application of treating coping motives as a single construct and splitting it into coping with depression and coping with anxiety (Conrod et al., 2000; Grant et al., 2007). Our results suggest that more research is needed to establish the construct validity of distinct coping motives and to disentangle these relationships across subpopulations of college student drinkers.

Overall Discussion

We sought to examine the associations among drinking motives, PBS use, and alcohol outcomes through the rep-

lication of three published studies using two independent samples. Our primary aim was to assess the reliability of the evidence for PBS use as a mediator in the drinking motives–alcohol outcomes relationship. Given that these studies differed in their analytic approach, we attempted to closely match the statistical approach used in each of the original studies and then determine if a specific approach had higher replicability and conceptual clarity.

Across each replication attempt, the only indirect effect that did not replicate (in terms of statistical significance) was the association between a single drinking motives latent variable and an alcohol use latent variable via a PBS use latent variable (LaBrie et al., 2011), which was the one case in which our study had less statistical power than the original study. Although a larger sample size likely would have resulted in finding a significant indirect effect, the

results from our other replication attempts provide evidence against examining a single latent variable with drinking motives subscales as indicators. Specifically, when examining drinking motives separately, they demonstrated differential relationships with PBS use and alcohol outcomes, suggesting that examining a single drinking motives variable could obfuscate the true relationships between drinking motives and alcohol outcomes. Thus, based on conceptual clarity, we caution researchers against examining a single latent factor of drinking motives.

Despite differences in whether variables were examined as latent or manifest and the target population (i.e., college students in general vs. LGBT college students), the key difference between the approach used by Martens et al. (2007a) and Ebersole et al. (2012) is that the former examined the indirect effects of each drinking motive on alcohol outcomes via PBS use while controlling for other drinking motives, whereas the latter examined each drinking motive in separate models. Thus, the former examined unique indirect effects via PBS use, whereas the latter examined total indirect effects via PBS use. This difference is more than a statistical nuance. We have stronger evidence that positively reinforcing drinking motives are related to using fewer PBS based on Replication 2, given that these effects remained when controlling for other drinking motives (i.e., ruled out more third-variable explanations). As the total indirect effects of coping motives on alcohol outcomes via PBS use in Replication 3 did not control for other drinking motives, these associations may be due entirely to the correlations between coping and positively reinforcing motives.

It is important to note that the indirect effects of drinking motives on alcohol outcomes via PBS were relatively weak compared with the total and/or direct effects of drinking motives on alcohol outcomes. Thus, despite some evidence that PBS use can help explain how drinking motives relate to alcohol outcomes, our results suggest that other variables are needed to fully explain why drinking motives are differentially related to alcohol outcomes.

Although there are alternative explanations, the observed negative associations between enhancement motives and PBS use may reflect a perceived conflict in the minds of college students who view heavier, less controlled drinking as maximizing the mood-enhancing effects of alcohol use. In other words, some college students may underutilize PBS based on their reasons for drinking, especially those who are drinking to enhance their mood. Thus, clinicians may want to recommend to these clients that using alcohol to enhance mood is not in conflict with drinking safely, and/or that using PBS to prevent negative consequences from drinking can be a strategy to drink moderately and enhance one's mood.

Although multiple studies have confirmed the three-factor structure of the PBSS (e.g., Martens et al., 2007b; Pearson et al., 2012a), some researchers have found support for a two-

factor (Madson et al., 2013) or four-factor solution (Walters et al., 2007). Although we know of no studies finding a single-factor solution for the PBSS, each of the studies reviewed above used either a single total score or latent variable with PBSS subscales as indicators, which again could obfuscate the true relationships among PBS use and alcohol outcomes.

Consistent with LaBrie et al. (2011), the Serious Harm Reduction subscale had a low factor loading on the PBS latent factor (.35), further suggesting that a single factor model is not ideal. Second-order models in SEM are appropriate when assessment instruments assess several related constructs, each measured by multiple items that are hypothesized to be accounted for by at least one higher-order construct (Chen et al., 2005). By using a second-order factor model within an SEM framework, one could examine whether the higher-order latent PBS variable accounts for indirect effects, or whether the lower-order PBS subtypes account for these relationships. In the studies discussed in this article, insufficient information is reported to assess the appropriateness of this approach. Of particular concern is the LaBrie et al. (2011) replication attempt where there were differences in the correlations among study variables by gender, implying a lack of measurement invariance across gender.

As were the original studies that we attempted to replicate, the present study was limited to the use of cross-sectional data and, thus, was unable to test a true mediation model. Longitudinal data are required to demonstrate temporal precedence, and experimental data are required to rule out third-variable explanations to make causal inferences. Thus, future research is needed to identify to what extent there are causal effects of drinking motives on alcohol outcomes and whether use of PBS can help explain these effects.

Some considerations while interpreting the present findings include (a) small differences in measurement strategies, (b) incongruous sample characteristics in replication attempt 3, (c) smaller sample size in replication attempt 1, and (d) demographic differences between our samples and the original samples of the three prior studies.

Overall, our replication attempts should highlight that apparent substantive discrepancies across studies on the mediating role of PBS can be largely attributed to methodological differences, specifically statistical decisions. We found the strongest evidence for PBS use partially mediating the association between enhancement motives and alcohol outcomes, but additional longitudinal/experimental research controlling for other factors is needed. Although PBS use may play a role in the associations between drinking motives and alcohol outcomes, it is clear that other factors are needed to fully explain these relationships.

References

- Chen, F. F., Sousa, K. H., & West, S. G. (2005). Teacher's corner: Testing measurement invariance of second-order factor models. *Structural Equations*

- tion Modeling: A Multidisciplinary Journal, 12, 471–492. doi:10.1207/s15328007sem1203_7.
- Collins, R. L., Parks, G. A., & Marlatt, G. A. (1985). Social determinants of alcohol consumption: The effects of social interaction and model status on the self-administration of alcohol. *Journal of Consulting and Clinical Psychology, 53*, 189–200. doi:10.1037/0022-006X.53.2.189.
- Conrod, P. J., Pihl, R. O., Stewart, S. H., & Dongier, M. (2000). Validation of a system of classifying female substance abusers on the basis of personality and motivational risk factors for substance abuse. *Psychology of Addictive Behaviors, 14*, 243–256. doi:10.1037/0893-164X.14.3.243.
- Cooper, M. L. (1994). Motivations for alcohol use among adolescents: Development and validation of a four-factor model. *Psychological Assessment, 6*, 117–128. doi:10.1037/1040-3590.6.2.117.
- Cooper, M. L., Russell, M., Skinner, J. B., & Windle, M. (1992). Development and validation of a three-dimensional measure of drinking motives. *Psychological Assessment, 4*, 123–132. doi:10.1037/1040-3590.4.2.123.
- Cox, W. M., & Klinger, E. (1988). A motivational model of alcohol use. *Journal of Abnormal Psychology, 97*, 168–180. doi:10.1037/0021-843X.97.2.168.
- D’Lima, G. M., Pearson, M. R., & Kelley, M. L. (2012). Protective behavioral strategies as a mediator and moderator of the relationship between self-regulation and alcohol-related consequences in first-year college students. *Psychology of Addictive Behaviors, 26*, 330–337. doi:10.1037/a0026942.
- Ebersole, R. C., Noble, J. J., & Madson, M. B. (2012). Drinking motives, negative consequences, and protective behavioral strategies in lesbian, gay, bisexual, and transgender college students. *Journal of LGBT Issues in Counseling, 6*, 337–352. doi:10.1080/15538605.2012.725650.
- Efron, B., & Tibshirani, R. J. (1993). *An introduction to the bootstrap*. Boca Raton, FL: CRC Press.
- Enders, C. K. (2001). The impact of nonnormality on full information maximum-likelihood estimation for structural equation models with missing data. *Psychological Methods, 6*, 352–370. doi:10.1037/1082-989X.6.4.352.
- Enders, C. K., & Bandalos, D. L. (2001). The relative performance of full information maximum likelihood estimation for missing data in structural equation models. *Structural Equation Modeling: A Multidisciplinary Journal, 8*, 430–457. doi:10.1207/S15328007SEM0803_5.
- Erceg-Hurn, D. M., & Mirosevich, V. M. (2008). Modern robust statistical methods: An easy way to maximize the accuracy and power of your research. *American Psychologist, 63*, 591–601. doi:10.1037/0003-066X.63.7.591.
- Fritz, M. S., & Mackinnon, D. P. (2007). Required sample size to detect the mediated effect. *Psychological Science, 18*, 233–239. doi:10.1111/j.1467-9280.2007.01882.x.
- Grant, V. V., Stewart, S. H., O’Connor, R. M., Blackwell, E., & Conrod, P. J. (2007). Psychometric evaluation of the five-factor Modified Drinking Motives Questionnaire–Revised in undergraduates. *Addictive Behaviors, 32*, 2611–2632. doi:10.1016/j.addbeh.2007.07.004.
- Ham, L. S., & Hope, D. A. (2003). College students and problematic drinking: A review of the literature. *Clinical Psychology Review, 23*, 719–759. doi:10.1016/S0272-7358(03)00071-0.
- Hu, L.-T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal, 6*, 1–55. doi:10.1080/10705519909540118.
- Jöreskog, K. G., & Sörbom, D. (1993). *LISREL 8: User’s guide*. Chicago, IL: Scientific Software.
- Kahler, C. W., Strong, D. R., & Read, J. P. (2005). Toward efficient and comprehensive measurement of the alcohol problems continuum in college students: The brief Young Adult Alcohol Consequences Questionnaire. *Alcoholism: Clinical and Experimental Research, 29*, 1180–1189. doi:10.1097/01.ALC.0000171940.95813.A5.
- Kline, R. B. (1998). *Principles and practice of structural equation modeling*. New York, NY: Guilford Press.
- Kuntsche, E., Knibbe, R., Gmel, G., & Engels, R. (2005). Why do young people drink? A review of drinking motives. *Clinical Psychology Review, 25*, 841–861. doi:10.1016/j.cpr.2005.06.002.
- LaBrie, J. W., Lac, A., Kenney, S. R., & Mirza, T. (2011). Protective behavioral strategies mediate the effect of drinking motives on alcohol use among heavy drinking college students: Gender and race differences. *Addictive Behaviors, 36*, 354–361. doi:10.1016/j.addbeh.2010.12.013.
- Madson, M. B., Arnau, R. C., & Lambert, S. J. (2013). Development and psychometric evaluation of the Revised Protective Behavioral Strategies Scale. *Psychological Assessment, 25*, 556–567. doi:10.1037/a0031788.
- Martens, M. P., Ferrier, A. G., & Cimini, M. D. (2007a). Do protective behavioral strategies mediate the relationship between drinking motives and alcohol use in college students? *Journal of Studies on Alcohol and Drugs, 68*, 106–114. doi:10.15288/jsad.2007.68.106.
- Martens, M. P., Ferrier, A. G., Sheehy, M. J., Corbett, K., Anderson, D. A., & Simmons, A. (2005). Development of the Protective Behavioral Strategies Survey. *Journal of Studies on Alcohol, 66*, 698–705. doi:10.15288/jsa.2005.66.698.
- Martens, M. P., Karakashian, M. A., Fleming, K. M., Fowler, R. M., Hatchett, E. S., & Cimini, M. D. (2009). Conscientiousness, protective behavioral strategies, and alcohol use: Testing for mediated effects. *Journal of Drug Education, 39*, 273–287. doi:10.2190/DE.39.3.d.
- Martens, M. P., Martin, J. L., Hatchett, E. S., Fowler, R. M., Fleming, K. M., Karakashian, M. A., & Cimini, M. D. (2008). Protective behavioral strategies and the relationship between depressive symptoms and alcohol-related negative consequences among college students. *Journal of Counseling Psychology, 55*, 535–541. doi:10.1037/a0013588.
- Martens, M. P., Pederson, E. R., LaBrie, J. W., Ferrier, A. G., & Cimini, M. D. (2007b). Measuring alcohol-related protective behavioral strategies among college students: Further examination of the Protective Behavioral Strategies Scale. *Psychology of Addictive Behaviors, 21*, 307–315. doi:10.1037/0893-164X.21.3.307.
- Muthén, L. K., & Muthén, B. O. (1998–2012). *Mplus user’s guide* (7th ed.). Los Angeles, CA: Authors.
- National Institute on Alcohol Abuse and Alcoholism. (2015). *College drinking*. Retrieved from <http://pubs.niaaa.nih.gov/publications/CollegeFactSheet/Collegefactsheet.pdf>
- Palmer, R. S., Corbin, W. R., & Cronce, J. M. (2010). Protective strategies: A mediator of risk associated with age of drinking onset. *Addictive Behaviors, 35*, 486–491. doi:10.1016/j.addbeh.2009.12.028.
- Pearson, M. R. (2013). Use of alcohol protective behavioral strategies among college students: A critical review. *Clinical Psychology Review, 33*, 1025–1040. doi:10.1016/j.cpr.2013.08.006.
- Pearson, M. R., Kite, B. A., & Henson, J. M. (2012a). The assessment of protective behavioral strategies: Comparing prediction and factor structures across measures. *Psychology of Addictive Behaviors, 26*, 573–584. doi:10.1037/a0028187.
- Pearson, M. R., Kite, B. A., & Henson, J. M. (2012b). Unique direct and indirect effects of impulsivity-like traits on alcohol-related outcomes via protective behavioral strategies. *Journal of Drug Education, 42*, 425–446.
- Prince, M. A., Carey, K. B., & Maisto, S. A. (2013). Protective behavioral strategies for reducing alcohol involvement: A review of the methodological issues. *Addictive Behaviors, 38*, 2343–2351. doi:10.1016/j.addbeh.2013.03.010.
- Walters, S. T., Roudsari, B. S., Vader, A. M., & Harris, T. R. (2007). Correlates of protective behavior utilization among heavy-drinking college students. *Addictive Behaviors, 32*, 2633–2644. doi:10.1016/j.addbeh.2007.06.022.
- White, H. R., & Labouvie, E. W. (1989). Toward the assessment of adolescent problem drinking. *Journal of Studies on Alcohol, 50*, 30–37. doi:10.15288/jsa.1989.50.30.