

The Relationship Between Risk Factors and Alcohol and Marijuana Use Outcomes Among Concurrent Users: A Comprehensive Examination of Protective Behavioral Strategies

ADRIAN J. BRAVO, PH.D.,^{a,*} ANDREW P. WEINSTEIN, B.S.,^b MATTHEW R. PEARSON, PH.D.,^a & PROTECTIVE STRATEGIES STUDY TEAM[†]

^aCenter on Alcoholism, Substance Abuse, and Addictions, University of New Mexico, Albuquerque, New Mexico

^bDepartment of Psychology, University of New Mexico, Albuquerque, New Mexico

ABSTRACT. Objective: Among college samples, both alcohol and marijuana protective behavioral strategies (PBS) have been shown to mediate the effects of known risk factors (i.e., sex, age at substance use onset, college substance use beliefs, substance use motives, and impulsivity-like traits) on alcohol and marijuana outcomes. However, it is unknown whether PBS use would operate similarly for both substances among concurrent users. The present study examined which risk factors relate to alcohol/marijuana outcomes via alcohol/marijuana PBS use among a large group of concurrent alcohol/marijuana users. **Method:** Participants were college students who consumed both alcohol and marijuana at least 1 day in the previous month ($n = 2,034$; 69.08% female). **Results:** Across both substances, PBS use significantly mediated the effects of sex (women reported higher PBS use), age at first use (having an older age

at first use was associated with more PBS use), and college substance use beliefs (higher beliefs was associated with lower PBS use). Unique to alcohol outcomes, alcohol PBS use significantly mediated the effects of negative urgency, social motives, and enhancement motives (all associated with lower PBS use). Unique to marijuana outcomes, marijuana PBS use mediated the effects of coping, expansion (both associated with lower PBS use), and conformity motives (associated with more PBS use). **Conclusions:** Our results suggest that PBS for both alcohol and marijuana can help explain why some risk factors are associated with alcohol/marijuana outcomes. Taken together, PBS use seems to be an important intervention target for alcohol/marijuana concurrent users. (*J. Stud. Alcohol Drugs*, 80, 102–108, 2019)

A RECENT REVIEW SHOWED that concurrent alcohol and marijuana (i.e., cannabis) use (i.e., use of both substances within a given period) is associated with higher rates of cannabis and alcohol use disorders, increased prevalence of mental health disorders, and appears to negatively affect treatment effects for both substances (Yurasek et al., 2017). Among college students, concurrent use of alcohol and marijuana has been shown to be associated with myriad negative consequences (Haas et al., 2015), including lower academic performance (Meda et al., 2017). From a harm reduction perspective, it is important to identify distinct risk/protective factors of problematic alcohol/marijuana use among concurrent users.

Protective behavioral strategies (PBS) are behaviors that are used immediately before (e.g., setting a limit on consumption), during (e.g., using only in a safe context), and/or after substance use (e.g., using a designated driver) that

reduce consumption, intoxication, and/or substance-related harm. Among college samples, increasing evidence suggests that both alcohol and marijuana PBS use are robust protective factors associated with lower substance use and negative consequences (alcohol: Pearson, 2013; Prince et al., 2013; marijuana: Pedersen et al., 2016, 2017). Further, several known risk factors associated with increased alcohol/marijuana use and consequences (e.g., male sex [Schulenberg et al., 2017]; earlier age at first use [Nelson et al., 2015]; college substance use beliefs [Osberg et al., 2010; Pearson et al., 2017]; impulsivity-like traits [Kaiser et al., 2012]; substance use motives [Cooper et al., 2016]) have been shown to be mediated by PBS use (Bravo et al., 2015, 2016, 2017b, 2017c; Ebersole et al., 2012; LaBrie et al., 2011; Martens et al., 2007; Palmer et al., 2010; Pearson et al., 2012). Specifically, risk factors have been shown to be associated with lower use of PBS, which in turn was

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*Correspondence may be sent to Adrian J. Bravo at the Center on Alcoholism, Substance Abuse, and Addictions, University of New Mexico, 2650 Yale Blvd. SE, Albuquerque, NM, 87106, or via email at: ajbravo@unm.edu. [†]This project was completed by the Protective Strategies Study Team, which includes the following investigators: Matthew R. Pearson, University of New

Mexico (coordinating principal investigator [PI]); Adrian J. Bravo, University of New Mexico (co-PI); Mark A. Prince, Colorado State University (site PI); Michael B. Madson, University of Southern Mississippi (site PI); James M. Henson, Old Dominion University (site PI); Alison Looby, University of Wyoming (site PI); Vivian M. Gonzalez, University of Alaska–Anchorage (site PI); Amber M. Henslee, Missouri University of Science and Technology (site PI); Carrie Cuttler, Washington State University (site PI); Maria M. Wong, Idaho State University (site PI); Dennis E. McChargue, University of Nebraska–Lincoln (site PI).

associated with higher alcohol/marijuana use and negative consequences.

However, it is unknown whether PBS use would operate similarly for both substances among concurrent users. Finding common (i.e., consistent effects across both substances) or unique (substance-specific effects) mediation effects could have important implications for interventions targeting college student concurrent alcohol/marijuana users. In an extension of previous research, the present study examined which risk factors uniquely (i.e., controlling for other factors) relate to alcohol/marijuana outcomes via alcohol/marijuana PBS use among a large group of concurrent alcohol/marijuana-using college students. Based on previous findings, we expected that “protective” factors (e.g., female sex, later age at first use) would be associated with greater PBS use, whereas “risk” factors (e.g., college substance use beliefs, negative urgency, coping motives) would be associated with less PBS use, which in turn would be associated with all substance use outcomes.

Method

Participants/procedures

College students age 18 years or older ($N = 7,307$) were recruited from Psychology Department Participant Pools at 10 universities across 10 U.S. states (for more details, see Bravo et al., 2018b) to participate in an online survey for research participation credit. To minimize the burden on participants, we used a planned missingness design, or matrix sampling (Graham et al., 2006; Schafer, 1997). For the present study, we limited our analytic sample to students who consumed both alcohol and marijuana in the previous month ($n = 2,034$). Among college student concurrent alcohol/marijuana users, the majority of participants identified as being White, non-Hispanic ($n = 1,297$ [63.8%]), female ($n = 1,405$ [69.08%]), and reported a mean age of 20.24 years ($Mdn = 19.00$, $SD = 3.16$, range: 18–49). This protocol was approved by institutional review boards at each participating university.

Measures

For all measures (unless noted), composite scores were created by averaging or summing items (reverse-coding items when appropriate) such that higher scores indicate higher levels of the construct (internal consistency of all study variables are presented in Supplemental Table S1—supplemental material appears as an online-only addendum to the article on the journal’s website).

Risk factors. Age at first use was assessed with two items: How old were you the first time you: (a) drank alcohol and (b) used marijuana. College alcohol beliefs were assessed using a 12-item version (Bravo et al., 2017a) of the College

Life Alcohol Salience Scale (Osberg et al., 2010). College marijuana beliefs were assessed using the 8-item Perceived Importance of Marijuana to the College Experience Scale (Pearson et al., 2017). Impulsivity-like traits (i.e., positive urgency, negative urgency, premeditation, perseverance, and sensation seeking) were assessed with the 20-item Short UPPS-P Impulsive Behavior Scale (Cyders et al., 2014). Past-month drinking motives (i.e., social, conformity, enhancement, drinking to cope with anxiety [DTC-anxiety], and drinking to cope with depression [DTC-depression]) were assessed using the 28-item Modified Drinking Motives Questionnaire–Revised (Grant et al., 2007). Past-month marijuana use motives (i.e., enhancement, conformity, expansion, coping, and social motives) were assessed using the 25-item Marijuana Motives Questionnaire (Simons et al., 1998).

PBS use. Past-month alcohol PBS use was assessed using the Protective Behavioral Strategies Scale-20 (Treloar et al., 2015). Although Treloar et al. (2015) dropped a manner of drinking item (“drink shots of liquor”) from the original measure (Martens et al., 2005) for psychometric reasons, we found that this item can be maintained by modifying the item to be consistent with the remaining items (“avoid drinking shots of liquor”). Marijuana PBS use was assessed using the 17-item version (Pedersen et al., 2017) of the Protective Behavioral Strategies–Marijuana Scale (Pedersen et al., 2016).

Substance use outcomes. Using a modified version of the Daily Drinking Questionnaire (Collins et al., 1985), participants indicated how many standard drinks they consumed during a typical week in the past 30 days using a 7-day grid from Monday to Sunday, which we summed to create a measure of alcohol use quantity. Using the Marijuana Use Grid (Pearson & Marijuana Outcomes Study Team, 2018), participants indicated how many grams of marijuana they consumed during a typical week in the past 30 days using a 7-day grid broken down into six 4-hour blocks of time (midnight–4:00 A.M., 4:00 A.M.–8:00 A.M., etc.) per day, which we summed to create a measure of marijuana use quantity. It is important to note that nearly one fourth of our sample exceeded the cutoff for hazardous drinking (23.2%; based on an Alcohol Use Disorders Identification Test score of 16 or higher; Babor et al., 2001) and hazardous marijuana use (21.9%; based on a Cannabis Use Disorder Identification Test–revised score of 13 or higher; Adamson et al., 2010). Negative consequences were assessed using the 24-item Brief-Young Adult Alcohol Consequences Questionnaire (Kahler et al., 2005) for alcohol and the 21-item Brief Marijuana Consequences Questionnaire (Simons et al., 2012) for marijuana.

Data analysis plan. To test study aims, a path model in which putative distal antecedents (i.e., sex, age at first use, college substance use beliefs, impulsivity-like traits, and motives) were modeled as predictors of negative

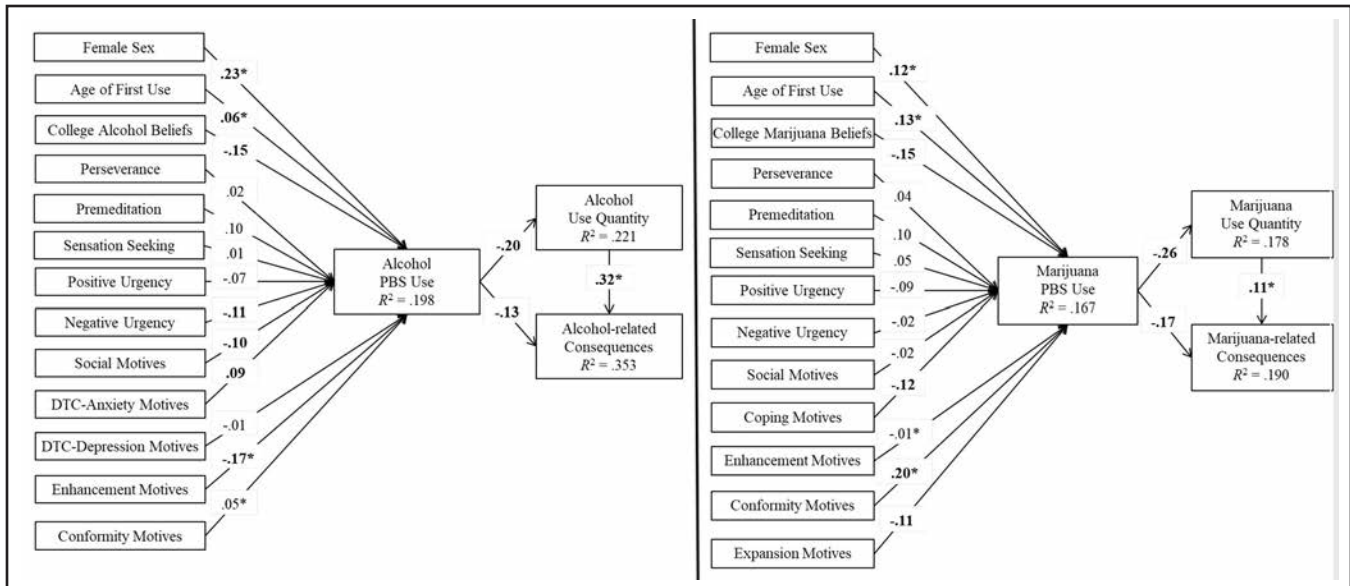


FIGURE 1. The standardized effects of the path model. Although all variables were entered into the same model, we split the figure by substance use outcome for clarity. The covariances among distal antecedents, between alcohol and marijuana protective behavioral strategies (PBS), between alcohol and marijuana use quantity, and between alcohol- and marijuana-related consequences, are not depicted for parsimony but are available on request. The direct effects of distal antecedents on alcohol/marijuana consumption and consequences are not shown in the figure for parsimony but are shown in Supplemental Tables 2 and 3. Significant associations are in **bold** for emphasis and were determined by a 99% bias-corrected standardized bootstrapped confidence interval (based on 10,000 bootstrapped samples) that does not contain zero. *Matched paths shown to be significantly different across substances via a Wald's test ($p < .01$) (see Supplemental Figures 1 and 2 for more details).

consequences via PBS use and substance use consumption was conducted using Mplus 7.4 (Muthén & Muthén, 1998–2018). Although all variables were entered into the same model (Figure 1), the model was not fully saturated such that specific substance use variables only predicted that specific substance use outcome (e.g., college alcohol beliefs → alcohol PBS use → alcohol use quantity → negative alcohol-related consequences). Missing data were handled using full information maximum likelihood (Muthén & Muthén, 1998–2017). We examined the total, direct, and indirect effects using bias-corrected bootstrapped estimates (Efron & Tibshirani, 1993), which provides a powerful test of mediation (Fritz & MacKinnon, 2007) and is robust to small departures from normality (Erceg-Hurn & Mirosevich, 2008). Statistical significance was determined by 99% bias-corrected bootstrapped confidence intervals (CIs) not containing zero.

Results

Bivariate correlations and descriptive statistics of all study variables are presented in Supplemental Table S1. The comprehensive mediation model provided an acceptable fit to the data based on most fit indices (Hu & Bentler, 1999), CFI = .946, RMSEA = .043 (90% CI [.037, .048]), SRMR = .016. The total, indirect, and direct effects for the mediation model are summarized in Supplemental Tables S2 (alcohol outcomes) and S3 (marijuana outcomes). An additional

model was conducted controlling for possible site differences, but results did not change and thus we present the more parsimonious model.

Shared mediation effects across both substances

Even when we controlled for all other predictors, PBS use was significantly negatively associated with all substance use outcomes. Across both substances, PBS use significantly mediated the associations between sex (women reported higher PBS use), age at first use, and college substance use beliefs on all substance use outcomes. Further, five (exception was age at first use to alcohol consequences) double-mediated associations were significant: (a/b) women → higher alcohol/marijuana PBS use → less alcohol/marijuana use quantity → fewer alcohol/marijuana consequences, (c) older age at first use → higher marijuana PBS use → less marijuana use quantity → fewer marijuana consequences, and (d/e) higher college alcohol/marijuana beliefs → lower alcohol/marijuana PBS use → more alcohol/marijuana use quantity → more alcohol/marijuana consequences.

Unique mediation effects for alcohol

Unique to alcohol outcomes, alcohol PBS use significantly mediated the associations of negative urgency, social motives, enhancement motives on each alcohol outcome, including the double-mediated paths: higher negative urgency/

social motives/enhancement motives → lower alcohol PBS use → more alcohol use quantity → more alcohol consequences. Although there were significant mediation effects for DTC-anxiety motives (Supplemental Table S2), caution must be exercised given that the direction of these effects (positive) contrasted with its negative bivariate correlation ($r = -.11$, Supplemental Table S1), indicating a suppression effect (Bravo & Pearson, 2017).

Unique mediation effects for marijuana

Unique to marijuana outcomes, marijuana PBS use significantly mediated the associations of coping, expansion, and conformity motives on each marijuana outcome, including the double-mediated paths: (a) higher coping/expansion motives → lower marijuana PBS use → more marijuana use quantity → more marijuana consequences and (b) higher conformity motives → higher marijuana PBS use → less marijuana use quantity → fewer marijuana consequences.

Exploratory test of differences in coefficients

To determine whether there were any statistically significant differences across substances for matched paths (e.g., conformity motives → alcohol PBS vs. conformity motives → marijuana PBS), we conducted tests of linear restrictions on the parameter estimates (standardized coefficients) using Wald's test (Muthén & Muthén, 1998–2018). Of 36 total paths that were tested for equality (Supplemental Figure S1), only 8 were significantly different ($p < .01$) across substances (Supplemental Figure S2): (a) sex → consequences (both significant but in opposite directions: alcohol $\beta = .13$; marijuana $\beta = -.10$), (b) sex → PBS use (both significantly positive but stronger association for alcohol [$\beta = .23$] than marijuana [$\beta = .12$]), (c) age at first use → PBS use (both significantly positive but stronger association for marijuana [$\beta = .13$] than alcohol [$\beta = .06$]), (d) positive urgency → consequences (significant positive association for alcohol [$\beta = .12$] but nonsignificant negative association for marijuana [$\beta = -.02$]), (e) enhancement motives → PBS use (significant negative association for alcohol [$\beta = -.17$] but nonsignificant positive association for marijuana [$\beta = .01$]), (f), conformity motives → PBS use (both positive but only significant for marijuana: alcohol $\beta = .05$; marijuana $\beta = .20$), (g) conformity motives → substance use (both nonsignificant but in opposite directions: alcohol $\beta = -.05$; marijuana $\beta = .04$), and (h) substance use → consequences (both significantly positive but stronger association for alcohol [$\beta = .32$] than marijuana [$\beta = .11$]).

Discussion

Using a large sample of college students who use both alcohol and marijuana, we examined whether PBS use

mediated the effects of several distinct factors previously identified to predict alcohol and/or marijuana outcomes. Consistent across both outcomes and with prior research examining these associations on a single substance use outcome (Bravo et al., 2016, 2017b, 2017c; Palmer et al., 2010), PBS use may partially explain (a) why women tend to use less alcohol/marijuana and experience fewer alcohol/marijuana consequences than men, (b) why individuals with a later age at onset tend to use less alcohol/marijuana and experience fewer alcohol/marijuana consequences than those with an earlier age at onset, and (c) why individuals who believe that using alcohol/marijuana is an integral part of the college experience tend to use more alcohol/marijuana and experience more alcohol/marijuana consequences than those who do not hold these beliefs.

Although several studies have demonstrated that beliefs about the perceived centrality of alcohol use to the college experience are robustly associated with alcohol outcomes (Bravo et al., 2017a; Osberg et al., 2010, 2011, 2012), this study builds from a smaller number of studies to demonstrate that the beliefs about the perceived centrality of marijuana use to the college experience are robustly associated with marijuana outcomes (Pearson et al., 2017, 2018). The internalization of college alcohol/marijuana use culture has been shown to mediate the effects of sensation seeking and impulsivity on alcohol/marijuana outcomes (Bravo et al., 2018a; Hustad et al., 2014; Pearson & Hustad, 2014; Pearson et al., 2018), and the present study shows that PBS mediates the effects of these beliefs on alcohol/marijuana outcomes. Given that they are clearly not immutable factors, these findings suggest that both college substance use beliefs and PBS use are possible intervention targets for reducing problems with both alcohol and marijuana.

Although the etiology of substance use problems is remarkably similar across distinct substances, it is important to test which factors predict uniquely across distinct substances so that we can identify the most salient intervention targets. Unique to alcohol outcomes and consistent with prior research examining these associations for only alcohol, alcohol PBS use significantly mediated the effects (all associated with lower PBS use) of negative urgency (Bravo et al., 2016; Pearson et al., 2012), social motives (Bravo et al., 2016; Martens et al., 2007), and enhancement motives (Bravo et al., 2016; Ebersole et al., 2012). Unique to marijuana outcomes and consistent with prior research examining these associations for only marijuana (Bravo et al., 2017c), marijuana PBS use mediated the effects of coping, expansion (both associated with lower PBS use), and conformity motives (associated with more PBS use). In testing whether path coefficients were equal across substances, only 8 (of 36 total paths) were significantly different across substances. Additional research is needed to replicate these unique findings, but these findings suggest that combined alcohol/marijuana interventions should account for the fact that alcohol and

marijuana use has both shared etiological pathways as well as unique etiological pathways.

Limitations and future directions

The cross-sectional/nonexperimental design prevents making causal inferences, which is especially important considering that event-level studies have found that certain types of PBS use are linked to more use or consequences (Lewis et al., 2012; Pearson et al., 2013); thus, additional research is needed to extend our findings using experimental (e.g., randomized controlled trials) and longitudinal (e.g., event-level) designs. Further, our convenience sampling method (i.e., use of Psychology Department pools) limits the generalizability of our results. Moreover, we cannot rule out that differences in associations across substances could be accounted for by small measurement differences, including different substance use motives (anxiety and depression-specific coping motives for alcohol, expansion motives for marijuana) and different units for quantity assessment (“standard drinks” for alcohol vs. grams for marijuana). Relatedly, the assessment of alcohol use quantity is much more standardized and likely more reliable than the assessment of marijuana use quantity (Pearson & Marijuana Outcomes Study Team, 2018). Last, we were unable to discern whether participants’ concurrent use was simultaneous (i.e., within the same substance use episode), and future research should examine whether PBS use differs during simultaneous versus independent use, as differences have been seen in other domains including perceived effects (Lee et al., 2017) and motives (Patrick et al., 2018).

Conclusions

Overall, we found more similarities across alcohol and marijuana outcomes than differences and our results suggest that PBS use for both alcohol and marijuana appears to be a central factor that can help explain why some risk factors are associated with alcohol/marijuana outcomes. Taken together, PBS use seems to be an important intervention target for concurrent alcohol/marijuana users. In addition to PBS use, the perceived importance of alcohol/marijuana use to the college experience appears to be a promising intervention target that should be further explored.

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