Simultaneous Alcohol and Marijuana Use: A Brief Measure of Motives

FIONA N. CONWAY, PH.D.,[a,*] ALEXANDER SOKOLOVSKY, PH.D.,[b] HELENE R. WHITE, PH.D.,[c,d] & KRISTINA M. JACKSON, PH.D.[b]

[a]*Steve Hicks School of Social Work, The University of Texas at Austin, Austin, Texas*
[b]*Center for Alcohol and Addiction Studies, Brown University School of Public Health, Providence, Rhode Island*
[c]*Center of Alcohol and Substance Use Studies, Rutgers, The State University of New Jersey, Piscataway, New Jersey*
[d]*Department of Sociology, Rutgers, The State University of New Jersey, Piscataway, New Jersey*

ABSTRACT. Objective: Increasing numbers of substance users report simultaneous alcohol and marijuana (SAM) use such that their effects overlap. More research is needed to understand what motivates this behavior, especially to inform interventions that address SAM use. A 26-item measure of SAM motives was designed and tested in previous research. The purpose of the current study was to validate that measure and create a briefer version of it. **Method:** Using two waves of data from a multi-site sample of college students (n = 1,014), exploratory and confirmatory factor analyses were conducted to develop a brief 11-item SAM Motives Measure (B-SMM). Negative binomial regression analyses were conducted to assess the reliability and validity of both the original and brief measures. **Results:** The brief measure contains four subscales (conformity, positive effects, calm/coping, and social) that match the empirically supported motivational model of substance use. Internal consistency of the subscales ranged from .77 to .87. Most subscales significantly predicted frequency and consequences of SAM use both concurrently and prospectively. **Conclusions:** The psychometrically sound measure developed in this study facilitates the examination of SAM motives in clinical settings with time-constrained patient contact and can be valuable for research involving frequent and repeated measures of substance use behaviors. (*J. Stud. Alcohol Drugs, 81,* 203–211, 2020)

THE PREVALENCE OF reported co-use of alcohol and marijuana has increased dramatically during the past two decades (Merrin et al., 2018; Terry-McElrath & Patrick, 2018; Yurasek et al., 2017). Individuals who use both substances may do so on separate occasions (concurrent alcohol and marijuana [CAM] use) or at the same time so that their effects overlap (simultaneous alcohol and marijuana [SAM] use) (Midanik et al., 2007; Patrick et al., 2019; Subbaraman & Kerr, 2015). Some of the negative consequences of co-use include impaired driving (Arterberry et al., 2017; Smart et al., 2018), sexual risk-taking (Fairlie et al., 2018; Hayaki et al., 2018), and violence (Lipperman-Kreda et al., 2017; Parker & Bradshaw, 2015). Most research has focused on CAM use, but given the effects of SAM use on adverse outcomes, SAM use requires particular attention (Pape et al., 2009; Skalisky et al., 2019). One area that would benefit from additional investigation is the motivations for SAM use.

The substance use motivational model, proposed by Cox and Klinger (1988), suggests that a dynamic set of personal characteristics, situational contexts, and expectancies about benefits and costs underlie motives to engage in substance use. These motives are driven by an individual's desire to approach a positive outcome or avoid an unpleasant one. Cooper (1994) refined Cox and Klinger's (1988) model from two broad categories (approach and avoidance) to create four subtypes. Approach motives have two subtypes: enhancement (e.g., to get a pleasant feeling) and social (e.g., to make social gatherings more enjoyable). Avoidance motives also have two subtypes: conformity (e.g., to avoid negative appraisals by peers) and coping (e.g., to avoid negative emotions such as anxiety or stress).

Numerous studies have provided empirical support for Cooper's (1994) model, and the majority examine alcohol and marijuana separately (Cooper et al., 2016; Davis et al., 2018; Grimaldi et al., 2016). SAM use, however, may be driven by individual characteristics and situational factors that are independent of alcohol or marijuana use. The findings in the alcohol and marijuana literature suggest that certain categories of motives have the same relationships regardless of substance type. For example, approach motives are positively related to use for both marijuana and alcohol use (Davis et al., 2018; Skalisky et al., 2019). The literature regarding specific subtypes, however, shows more complex associations that may vary across type of outcomes and possibly type of substance. For example, findings regarding conformity motives are inconsistent (Cooper et al., 2016). Some studies have not detected a relationship between conformity motives and substance use (Bonn-Miller et al., 2007; Loxton et al., 2015), whereas others have found negative associations (Patrick et al., 2018; Skalisky et al., 2019). Therefore, identifying the salience of motives that specifically apply to

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*Correspondence may be sent to Fiona N. Conway at the Steve Hicks School of Social Work, The University of Texas at Austin, 1925 San Jacinto Boulevard, Austin, TX 78712, or via email at: fiona.conway@utexas.edu.

SAM use is important. Treatments that address the motivational aspects of SAM use are crucial but are possible only if specific motives are known.

Consistent identification of SAM use motives requires a psychometrically validated measure. Most studies on substance use motives have focused on the development and refinement of separate measures for alcohol and marijuana use (Grant et al., 2007; Lee et al., 2009), with the one exception being a study by Patrick et al. (2018). Their goal was to develop and test a 26-item measure of motives for SAM use. The items in their measure were developed using information obtained from qualitative data (answers to open-ended questions), literature regarding perceptions of the effects of SAM use, and literature regarding motives for alcohol and marijuana use. Eight of the items pertain specifically to simultaneous use and are distinct from other items that can be generalized to any type of substance (e.g., "to increase the positive effects I get from alcohol"). Their measure has four factors (conformity, positive effects, calm/coping, and social) that align with the widely accepted motivational model of substance use (Cooper, 1994). Patrick and colleagues (2018) conducted regression analyses to assess the validity of their measure and found that various subscales on their SAM motives measure significantly predicted SAM use, alcohol use, marijuana use, and marijuana (but not alcohol) consequences (for details, see Patrick et al., 2018). No studies have attempted to validate this measure in a different sample, or with prospective data and more nuanced outcomes (i.e., with SAM consequences).

The measure developed by Patrick and colleagues (2018) can provide rich data for researchers and clinicians. In some situations, however, a measure with fewer items would be more beneficial. Examples include clinical settings where practitioners have limited time with patients or research projects where participants may experience fatigue from completing a battery of psychosocial measures. Also, substance use studies often use methods such as daily diaries and ecological momentary assessments (Cohn et al., 2011; Dworkin et al., 2017), which collect frequent and repeated measures. A briefer measure would be ideal for such use. Measurement theory also supports the creation and validation of short instruments. Thurstone (1934), a pioneer in the scale development field, argued that a valued attribute of scales is simplicity as well as reliability and validity (see also DeVellis, 2012; Hinkin, 1998).

Our study had two aims. The first was to validate the initial Patrick et al. (2018) SAM motives measure in a different sample. In so doing, we analyzed the incremental validity of the measure to determine if the SAM motives measure is associated with SAM use above and beyond measures of alcohol or marijuana motives alone. The second aim was to develop a brief form of the SAM motives measure. A prospective study design (collecting two waves of data) was used to accomplish the two aims.

Method

Design and sample

Students from three state universities were recruited for the study. Each university was located in a different state with specific marijuana legislation. In one state, recreational use by adults age 21 years and older is legalized (School A); in the second state, marijuana use is decriminalized (School B); and in the third state, marijuana possession and use is a criminal offense (School C). Email invitations to complete an online screening survey were sent to a random selection of 8,000 students in each school's registrar database (N = 24,000 total). A comparison of demographic characteristics of the 7,000 (29%) students who completed the screening survey with information provided by the registrars for the 24,000 indicated that screening completers included more women, more White students, fewer Black students, more Asian students, and more Hispanic/Latinx students and were more likely to be younger. Effect sizes of differences in the demographic characteristics were small, suggesting that the screening sample was fairly representative of the students attending the three universities (for details, see White et al., 2019).

Eligibility criteria were met by 2,874 students based on the following: They used marijuana and alcohol in the past year, were between the ages of 18 and 24 years, and were enrolled full time, and their email addresses matched with the university registrar database. A stratified sampling strategy was used to invite 2,501 eligible students to complete the baseline survey, oversampling individuals who used alcohol and marijuana in the past 30 days to ensure enough monthly users for a daily survey second phase of the study. The survey was completed by 60.9% (n = 1,524) of the invited students, and 1,390 were eligible and provided usable data. Those who completed the baseline survey could not be compared to those who did not, as individual-level screening data were not retained due to institutional review board requirements. Students were followed up 3 months later and 89.8% (n = 1,248) of those who completed the baseline survey also completed the follow-up survey. Attrition analysis indicated no significant differences in attrition rates by alcohol, marijuana, and SAM frequency or by age, sex, race, or school. (For greater detail on recruitment, see White et al. [2019] and Supplemental Figure 1.) (Supplemental material appears as an online-only addendum to the article on the journal's website.)

For this study, SAM use was defined as using alcohol and marijuana at the same time so that their effects overlapped. Students who reported SAM use during the past year (baseline n = 1,014 and follow-up n = 904) were included in the data analysis for this study. At baseline, 80.7% (n = 818) of participants reported engaging in SAM use at least once in the past 3 months. At follow-up, 611 participants reported

engaging in SAM use at least once in the past 3 months. This number reflects a loss of 177 participants who reported use at baseline but not at follow-up (including 113 participants who did not complete the follow-up survey), and 63 new SAM users emerged. The participants were 66.9% non-Hispanic White, were 61.2% female, and had a mean age of 19.8 years old (Table 1). The study was approved by the coordinating university institutional review board, and the National Institute on Drug Abuse provided a Certificate of Confidentiality.

Table 1. Sample characteristics at baseline (n = 1,014)

Variable	M (SD) or %
Age (range: 18–24)	19.84 (1.33)
Gender	
Female	61.24
Male	38.76
School	
School A	35.60
School B	36.00
School C	28.40
Race/ethnicity	
American Indian/Alaskan Native	0.10
Asian	10.26
Hispanic	12.03
Native Hawaiian/other Pacific Islander	0.10
Non-Hispanic Black/African American	2.56
Non-Hispanic White	66.86
Mixed	7.40
Other	0.69
SAM use (days used past 3 months)	5.90 (11.03)
SAM consequences (range: 0–28)	2.21 (3.53)

Notes: For regression analyses, race/ethnicity was recoded (Asian, other, White). SAM = simultaneous alcohol and marijuana.

Measures

Motives. Motives for SAM, alcohol, and marijuana use were assessed, respectively, using the SAM motives measure developed by Patrick et al. (2018; α = .89), the Drinking Motives Questionnaire, Revised (DMQ-R; Cooper, 1994; α = .90), and the Marijuana Motives Measure (MMM; Simons et al., 1998; α = .92). For the SAM motives measure, four subscales were used (conformity, positive effects, calm/coping, and social). For alcohol and marijuana motives, three subscales were used (enhancement, coping, and social). Conformity motives for alcohol and marijuana use were excluded from the questionnaire to keep it shorter. Although some of the subscales on the SAM measure are labeled differently than the corresponding subscales on the alcohol and marijuana measures, they capture the same constructs. For example, the calm/coping subscale of the SAM measure and the coping subscale of the alcohol and marijuana measure have a very similar set of items, and the positive effects subscale (SAM motives measure) is analogous to the enhancement scale (alcohol and marijuana motives measures).

SAM use. Frequency of SAM use was measured by how often students used alcohol and marijuana at the same time so that their effects overlapped during the past 3 months on a scale from 0 (*did not use*) to 7 (*once a day or more often*). Number of days used was calculated by converting the ordinal categories using the midpoint when appropriate. Responses ranged from 0 days to 90 days (M = 5.84, SD = 10.90).

SAM use consequences. Students were provided with a list of negative consequences from the 24-item Brief Young Adult Alcohol Consequences Questionnaire (Kahler et al., 2005) and the 21-item Brief Marijuana Consequences Questionnaire (Simons et al., 2012), which have been validated on college samples. Collapsing the two scales yielded 28 unique items. Items were preceded by "below is a list of things that sometimes happen to people either during, or after they have been drinking alcohol or using marijuana. Please check whether or not these things have happened to you because of your alcohol use alone, your marijuana use alone, and/or because of using alcohol and marijuana together so that their effects overlapped in the past 3 months." The sum of the number of affirmative responses for using alcohol and marijuana together so that their effects overlapped was used to create a total SAM consequence score, ranging from 0 to 28 (M = 2.14, SD = 3.53; α = .88).

Demographic characteristics. Age (continuous), sex (male vs. female as reference), race/ethnicity (White vs. Asian vs. other as reference), and school attended (School A as reference vs. School B and School C) were controlled for in the analyses.

Analysis plan

Reliability and validity (original measure). Negative binomial hierarchical regression models were constructed to validate the original Patrick et al. (2018) measure using data collected at baseline. The models assessed the concurrent incremental validity of the original SAM motives measure above and beyond motives for alcohol and marijuana use. We also assessed the internal consistency reliability of each factor.

Factor analysis. To develop a brief format of the SAM motives measure, we randomly divided the sample into two halves using the data collected at baseline. Using the first half of the sample, we determined the number of factors using parallel analysis (Humphreys & Montanelli Jr., 1975) of the 26 items developed by Patrick et al. (2018). We also conducted an exploratory factor analysis using oblique rotation to determine an empirically derived factor structure while allowing for correlations among putative motives. Factor structure and item loadings were evaluated relative to those reported by Patrick et al. (2018). We iteratively removed items with factor loadings below threshold levels (i.e., <.50), and those with factor cross-loadings above threshold levels (i.e., >.30) to identify candidate items for the brief measure. We selected those items with the strongest factor loadings

Table 2. The association of the original SAM motives measure at baseline with SAM use at baseline (n = 1,014)

	Model 1			Model 2		
Variable	Standardized estimate	Standard error	Wald χ^2	Standardized estimate	Standard error	Wald χ^2
Intercept	1.66	0.11	225.17***	1.60	0.11	223.95***
Age	0.15	0.04	13.07***	0.12	0.04	7.94**
Male[a]	-0.17	0.04	14.61***	-0.16	0.04	14.75***
White[b]	-0.20	0.05	13.65***	-0.19	0.05	13.63***
Asian[b]	-0.13	0.08	2.59	-0.14	0.08	3.28
School B[c]	-0.09	0.10	0.71	-0.11	0.10	1.23
School C[c]	0.03	0.05	0.37	0.04	0.05	0.71
Alcohol motives[d]						
Enhancement	0.07	0.06	1.22	0.00	0.06	0.00
Coping	0.12	0.06	4.87*	0.11	0.06	2.95
Social	-0.09	0.06	2.24	-0.05	0.06	0.63
Marijuana motives[d]						
Enhancement	0.44	0.06	46.97***	0.35	0.06	30.55***
Coping	0.19	0.06	9.88**	0.03	0.06	0.23
Social	0.01	0.06	0.01	-0.07	0.07	0.98
SAM motives						
Conformity				-0.37	0.05	57.26***
Positive effects				0.09	0.06	2.67
Calm/coping				0.27	0.06	24.71***
Social				0.27	0.07	15.72***

Notes: Reference group = [a]Female, [b]other, [c]School A, [d]motives that capture the same construct are named differently on the validated measures (enhancement = positive effects, coping = calm/coping). Alcohol conformity motives and marijuana conformity motives were excluded from the analyses (see text for explanation). SAM = simultaneous alcohol and marijuana. *p < .05; **p < .01; ***p < .001.

on the retained factors to include in our final measure and reviewed each subscale to ensure sufficient coverage of relevant constructs. Cronbach's alpha (three-item factors) and Spearman–Brown reliability coefficients (two-item factor; Eisinga et al., 2013) were computed to assess the internal consistency of the retained items. Last, using the second half of the sample, we fit a confirmatory factor analysis model including all retained items to evaluate model fit. We report the chi-square, standardized root mean square residual, root mean square error of approximation, comparative fit index, and Tucker–Lewis index of the confirmatory model.

Reliability and validity (brief measure). We explored the associations between motives and frequency of SAM use and number of SAM consequences to demonstrate the validity of the SAM motives brief measure. For the first set of analyses, we used data from the baseline survey to demonstrate concurrent incremental validity. The second set was conducted using data from the follow-up survey to assess predictive validity, rigorously controlling for baseline use and consequences. We also assessed the internal consistency reliability for each factor.

Results of Wald tests of statistical significance were generated with negative binomial regression models for each validity analysis. Age, sex, race/ethnicity, and school were added as covariates to all of the models, and all of the predictor variables were standardized to facilitate comparison of the beta coefficients. Descriptive, reliability, and validity analyses were conducted in SAS 9.4 (SAS Institute, Cary, NC); we used Mplus 6.12 (Muthén & Muthén, 1998–2011) for the exploratory factor analysis and confirmatory factor analysis.

Results

Reliability and validity (original measure)

Internal consistency reliability was calculated, and the original measure demonstrated acceptable to good performance for each factor as follows: conformity (α = .82), positive effects (α = .91), calm/coping (α = .70), and social (α = .79). Using the baseline data, the results of the negative binomial regression models demonstrated concurrent incremental validity of the original SAM motives measure in that almost every subscale of the measure was significantly associated with SAM use above and beyond the alcohol and marijuana motives measures (Table 2). In the first set of analyses (Table 2: Model 1), alcohol coping motives and marijuana enhancement and coping motives were significantly associated with SAM use. When SAM motives were added to the analyses (Table 2: Model 2), all of the SAM motives factors, except positive effects, were associated with use. We also compared the Akaike information criterion (AIC) and Bayesian information criterion (BIC) model fit statistics between the two models (lower is better). The AIC and BIC for the SAM motives model were lower by 111.99 and 92.34, respectively, than the model without SAM motives.

Factor analysis

In the first half of the sample, parallel analysis identified five factors (see Supplemental Table 1) present in the baseline SAM motives data beyond which eigenvalues of random data

Table 3. Baseline exploratory factor analysis factor loadings and proportion of variance explained by each factor for the brief measure (n = 507)

Variable	Conformity	Positive effects	Calm/ coping	Social
So that others won't kid me about not using	**.82**	.00	.05	.00
Pressure from others	**.84**	.00	.00	-.05
To fit in with a group I like	**.89**	.01	-.04	.03
Cross-faded effects are better	-.02	**.60**	-.06	.20
To increase the positive effects I get from alcohol	.01	**.91**	.01	-.04
To increase the positive effects I get from marijuana	.00	**.84**	.03	.01
To calm me down	-.03	-.01	**1.00**	.00
To cope with anxiety	.13	.08	**.59**	.03
Because it makes special occasions more enjoyable	.00	.09	.02	**.74**
Because it is customary on special occasions	.27	-.08	.09	**.52**
As a way to celebrate	-.05	.00	-.01	**.79**
Proportion of total variance accounted for by factor	.21	.18	.13	.15
Proportion of explained variance accounted for by factor	.32	.27	.19	.22

Note: **Bold** indicates item loaded .50 or higher.

exceeded those of observed data. Using oblique rotation and specifying five factors to extract, an exploratory factor analysis was conducted with the same half of the sample. Consistent with Patrick et al. (2018), four items did not load on any of the four factors (i.e., "because of boredom," "to offset the negative effects I get from alcohol," "to offset the negative effects I get from marijuana," and "using marijuana helps me to drink more alcohol"). In addition, these items were not highly correlated (ranging from .06 to .28) with SAM use or consequences. An additional two items ("looking for a new experience" and "to be sociable") also did not load on any of the factors. These six items were omitted from further analyses.

We then iteratively refit factor solutions while removing items that did not load on any factors (one item) and cross-loaded items (four items) ("to help me sleep"—low factor loading, *Iteration 1;* "to get a better high"—cross-loaded, *Iteration 2;* "to be liked" and "to increase intoxication"—cross-loaded, *Iteration 3;* and, "because it is what most of my friends do when we get together"—cross-loaded, *Iteration 4*) until a stable factor solution was reached (Supplemental Table 1). Examining this solution we observed considerable overlap between two factors on items querying conformity motives that were not substantively theoretically distinct. We collapsed these factors and fit a four-factor solution (Supplemental Table 2). As our goal was to select three items for each factor, we selected those items with the highest factor loadings. Because there were only two items pertaining to calm/coping, both were retained. All retained items, their factor loadings, and the proportion of total variance and explained variance accounted for by each factor can be found in Table 3.

Use of oblique rotation was supported by factor correlations ranging from .10 (conformity with positive effects) to .59 (positive effects with social), generally above the typical ±.32 cutoff (10% of variance on any inter-factor correlation) for oblique rotations (Tabachnick & Fidell, 2007). Item loadings ranged from λ = .82 to .89 for conformity, λ = .60 to .91 for positive effects, λ = .59 to 1.00 for calm/coping, and λ = .52 to .79 for social motives. (Note that the exploratory factor analysis treated the ordinal measures as continuous. However, we repeated the analyses treating the items as ordered categorical variables, and the resulting categorical analyses did not substantively differ from the continuous analyses.)

The factor structure and items derived from the exploratory analyses in the first half of the sample were used to fit a confirmatory model in the second half of the sample. This confirmatory factor analysis model demonstrated acceptable fit, $\chi^2(38) = 130.70$, $p < .01$; comparative fit index = .966; Tucker–Lewis index = .951; root mean square error of approximation = .070; standardized root mean square residual = .047.

Reliability and validity (brief measure)

Baseline survey: Concurrent incremental validity. The brief measure demonstrated good internal reliability for each factor as follows: conformity (α = .86), positive effects (α = .87), calm/coping (α = .77), and social (α = .77). The brief measure also demonstrated good, concurrent incremental validity. After we controlled for alcohol and marijuana motives, every subscale was significantly associated with frequency of SAM use (Table 4). Higher scores for the positive effects, calm/coping, and social motives were associated with increased SAM use. In contrast, higher conformity motives were associated with lower frequency of SAM use. Higher scores for conformity, positive effects, and social motives were significantly associated with more SAM consequences. Calm/coping motives were not associated with consequences.

Follow-up survey: Predictive validity. We predicted SAM use and consequences at follow-up from the brief SAM motives measure, rigorously controlling for baseline SAM use and consequences, respectively. Several subscales on the

TABLE 4. The association of the brief SAM motives measure at baseline with SAM use and consequences at baseline (n = 1,014)

	Baseline SAM use			Baseline SAM consequences		
Variable	Standardized estimate	Standard error	Wald χ^2	Standardized estimate	Standard error	Wald χ^2
Intercept	1.63	0.11	224.75***	0.37	0.13	8.05**
Age	0.15	0.04	11.47***	0.06	0.05	1.65
Male[a]	-0.17	0.04	15.92***	-0.07	0.05	2.08
White[b]	-0.20	0.05	14.93***	-0.03	0.06	0.23
Asian[b]	-0.14	0.08	2.95	0.07	0.10	0.49
School B[c]	-0.12	0.10	1.46	0.18	0.12	2.27
School C[c]	0.04	0.05	0.66	0.12	0.06	3.59
Alcohol motives[d]						
Enhancement	0.00	0.06	0.00	0.16	0.08	4.38*
Coping	0.09	0.06	2.33	-0.01	0.07	0.03
Social	-0.05	0.06	0.80	0.03	0.07	0.18
Marijuana motives[d]						
Enhancement	0.36	0.06	31.84***	0.23	0.07	9.82***
Coping	0.06	0.06	0.97	0.15	0.08	3.46
Social	-0.08	0.07	1.40	-0.13	0.08	3.07
SAM motives						
Conformity	-0.20	0.05	19.67***	0.15	0.05	8.26**
Positive effects	0.14	0.05	6.96**	0.22	0.07	11.88***
Calm/coping	0.20	0.06	12.66***	0.04	0.07	0.43
Social	0.18	0.06	8.67**	0.16	0.07	4.99*

Notes: Reference group = [a]Female, [b]other, [c]School A, [d]motives that capture the same construct are named differently on the validated measures (enhancement = positive effects, coping = calm/coping). Alcohol conformity motives and marijuana conformity motives were excluded from the analyses (see text for explanation). SAM = simultaneous alcohol and marijuana.
*p < .05; **p < .01; ***p < .001.

brief measure demonstrated predictive validity (Table 5). Conformity, positive effects, and social motives were significant prospective predictors of SAM use when we controlled for prior use, and social motives was a significant prospective predictor of SAM consequences when we controlled for prior consequences.

SAM measures comparison. Finally, we explored how predictive validity of the brief measure compared to that of the original measure. A notable finding was that the results of the brief measure were consistent with the original measure for conformity and positive effects (compare Table 5 and Supplemental Table 3). For both measures, scores on these factors were significantly associated prospectively with frequency of SAM use. Social motives on the brief measure prospectively predicted use, but there was no significant association for this factor in the model with the original measure. Also, each measure had one factor that predicted SAM consequences. For the original measure, positive effects were significant; for the brief measure, social motives were significant.

Discussion

Our study aims were to replicate the validity findings for a measure of SAM use motives developed by Patrick et al. (2018) and to create a brief version of the measure. The study used data collected from students enrolled in three universities at two time points 3 months apart. Our results successfully replicated the original study in a new sample of college students and demonstrated that the original measure was reliable and had incremental validity above and beyond measures of alcohol motives and marijuana motives. This is an important finding given that the studies were conducted with different designs. Specifically, the original study was conducted with a community sample of 286 participants from one state, and the SAM use outcome was binary in nature (past-month SAM use was coded as "0 times" vs. "at least one time"). Our study used a sample of 1,014 participants from three states, and our measure of SAM use was number of days used during the past 3 months. It is notable that the original SAM motives measure has proven to be reliable and valid in two different samples of emerging adults. Future studies will need to validate the scale with other age groups.

We also successfully developed and validated a brief version of the original measure. Patrick and colleagues (2018) originally tested 26 items and removed four items ("because of boredom," "to offset the negative effects I get from alcohol," "to offset the negative effects I get from marijuana," and "using marijuana helps me to drink more alcohol") for their subsequent psychometric analyses because they did not load on any of the subscales. Our results were consistent with Patrick et al. (2018), and we also removed these items. It is worthwhile to note, however, that although the results of statistical analysis support the removal of these items from the scale, three of them have conceptual value because they

TABLE 5. The association of the brief SAM motives measure with follow-up SAM use and consequences (n = 904)

	Use			Consequences		
Variable	Standardized estimate	Standard error	Wald χ^2	Standardized estimate	Standard error	Wald χ^2
Intercept	1.55	0.12	167.37	0.34	0.15	5.23
Age	-0.05	0.05	1.15	0.03	0.06	0.26
Male[a]	-0.11	0.05	5.10*	-0.07	0.06	1.38
White[b]	-0.12	0.06	4.16*	0.03	0.07	0.20
Asian[b]	-0.17	0.09	3.49	-0.12	0.11	1.19
School B[c]	-0.31	0.12	7.11*	0.00	0.14	0.00
School C[c]	-0.08	0.06	1.69	0.20	0.07	7.33**
SAM use (baseline)	0.65	0.06	108.51***			
SAM consequences (baseline)				0.65	0.07	89.90***
SAM motives						
Conformity	-0.12	0.05	7.18**	-0.02	0.06	0.13
Positive effects	0.21	0.06	12.44***	0.07	0.07	0.99
Calm/coping	0.03	0.06	0.22	0.05	0.07	0.50
Social	0.15	0.06	5.81*	0.17	0.07	5.70*

Notes: Reference group = [a]Female, [b]other, [c]School A. SAM = simultaneous alcohol and marijuana.
*p < .05; **p < .01; ***p < .001.

pertain specifically to simultaneous use and are distinct from other items that can be generalized to any type of substance. Our analyses showed that, after removing the four items, the number could be reduced further from 22 to 11 items and maintain the same factor structure of the original measure. Results showed that each subscale on the brief measure had acceptable or good internal consistency. The measure also demonstrated concurrent (baseline data) and predictive (follow-up data) validity. Our results suggest that the Brief SAM Motives Measure (B-SMM) is a reliable and valid measure of motives for SAM use.

Many of the results of our analyses of the relationship between SAM motives and SAM use and consequences are consistent with findings from previous research in both the alcohol and marijuana fields. More than two decades ago, Cooper (1994) provided evidence that approach motives (i.e., positive effects and social motives) predict higher consumption. We found the same results using the brief measure of SAM motives in our study. Positive effects and social motives were not only concurrently associated with more frequent SAM use but also predicted SAM use prospectively, over and above baseline level of use (i.e., predicting change in SAM use over a 3-month follow-up period). Most studies conducted on alcohol and marijuana motives have also reported associations of positive effects and social motives with use (e.g., Buckner et al., 2019; Kuntsche et al., 2005; Skalisky et al., 2019).

We also found that positive effects were associated with consequences at baseline. This relationship may be indirect and driven by high levels of use. That is, individuals motivated by positive effects may have a higher frequency or heavier pattern of SAM use, which in turn can lead to experiencing more consequences. Finally, social motives were predictive of change in SAM consequences from baseline to follow-up. In our tests of concurrent incremental validity, there was a strong effect of marijuana enhancement motives in predicting SAM use and consequences. In fact, this effect was stronger than the comparable positive effects of SAM motives in our replication of the original study using the full-length measure. In our analysis using the brief measure, the results were less divergent. Future work should explore these differences as well as the specificity of substance motivations at a more fine-grained event level.

Support for avoidance motives (calm/coping and conformity) in the alcohol and marijuana literature is mixed. In general, calm/coping motives for alcohol and marijuana use are associated with higher consequences (Davis et al., 2018; Grimaldi et al., 2016). In our study, however, calm/coping motives were associated with SAM use (at baseline) but not consequences at either time point. The study by Patrick et al. (2018) also found significant associations between calm/coping motives and SAM use. Our findings for conformity motives are consistent with the alcohol and marijuana literature, which indicates that when conformity motives are related to use, they are related to less rather than more use (Cooper et al., 2016). Our results show the same relationship and mirror the findings of Patrick et al. (2018). It may be that avoiding social rejection (i.e., conformity) may motivate experimental/light use but is not a salient factor for frequent use. Overall, the results from our study suggest that the relationships between SAM motives and SAM use outcomes behave similarly to those for alcohol and marijuana for approach motives (i.e., positive effects and social motives) but not for avoidance motives (i.e., conformity and calm/coping). This suggests that the mechanisms that underlie the connection between avoidance motives and substance use outcomes may be different for SAM use as compared with those for alcohol and marijuana.

Some limitations of the study should be considered when interpreting the findings. The participants were all members

of a homogenous age group and educational status (i.e., 18- to 24-year-old university students). As such, the findings are only generalizable to these demographic categories and still only to volunteer students at three specific universities. Future research should use a recruitment strategy that targets a more diverse demographic population and test for differential predictive ability of the motives across groups differing in demographic characteristics and state marijuana policies. Another limitation is the use of one type of reliability test (internal consistency) and a few types of validity tests (concurrent incremental validity and predictive validity). Future research should use additional tests such as convergent validity, discriminant validity, and parallel forms reliability. Despite these limitations, this study adds to the body of work examining SAM use. Further, it extends research by providing empirical support for a brief psychometrically sound measure of SAM use motives. The B-SMM will facilitate exploration of motives for SAM use in research and clinical settings where time constraints previously prohibited investigation of this potentially risky behavior.

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