Regulate yourself: Emotion regulation and protective behavioral strategies in substance use behaviors

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HIGHLIGHTS

- Reappraisal was positively associated with alcohol- and cannabis-related PBS.
- Suppression was negatively associated with alcohol-related problems among males.
- Reappraisal and PBS use predicted fewer cannabis-related problems among males.
- Emotion regulation flexibility may be important for substance-related outcomes.

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ABSTRACT

Although research suggests links between emotion regulation strategies and substance use outcomes, little work has examined the relationship between specific strategies (i.e., reappraisal and suppression) and outcomes (i.e., alcohol and cannabis consumption and related problems). To date, no research has examined the association between emotion regulation strategies and protective behavioral strategies used while engaging in substance use. Thus, the current study examined these relations for females and males. Undergraduates ($N = 643$) completed an online battery of self-report measures. Using structural equation modeling, results indicated improved Emotion Regulation Questionnaire model fit after one item was removed. Reappraisal was negatively associated with alcohol binge frequency and related problems for females, though suppression was negatively related to these outcomes for males. Reappraisal was also negatively associated with cannabis-related problems for males only. Reappraisal was positively associated with all types of protective behavioral strategies use for females, whereas only alcohol-specific serious harm reduction and cannabis protective behavioral strategies were significant for males. Latent variable interactions between reappraisal and protective behavioral strategies were significant for past-month cannabis use and related problems for males and indicated protective behavioral strategies use was more protective against past-month use and cannabis-related problems for those high in reappraisal. Although replication is necessary, these preliminary findings suggest the link between emotion regulation strategies and substance use outcomes among college students is complex and future work may benefit from examining these relations from an emotion regulation flexibility perspective.

1. Introduction

Much research has indicated a link between emotion regulation (ER) processes and substance use (e.g., Aldao, Nolen-Hoeksema, & Schweizer, 2010; Axelrod, Perepletchikova, Holtzman, & Sinha, 2011; Cooper, Frone, Russell, & Mudar, 1995; Khantzian, 1997). One well-accepted model of ER is the process model (Gross, 2002; Gross, 2014). According to Gross (1998b), "emotion regulation refers to the processes by which individuals influence which emotions they have, when they have them, and how they experience and express these emotions" (p. 275). Using the process model, specific ER strategies are not judged as "good" or "bad," as strategies can be viewed as adaptive or maladaptive, depending on the context and outcome (see Gross, 1998a; Gross, 1998b). Despite this, the literature tends to dichotomize specific ER strategies as adaptive (e.g., reappraisal) or maladaptive (e.g., suppression). Reappraisal is typically conceptualized as a form of adaptive,

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antecedent-focused regulation strategy in which cognitive intervention yields change in emotional experience, leading to a modified set of cognitive and behavioral responses (Gross, 2001). Suppression is a form of maladaptive, response-modulation-based regulation which aims to dampen emotional responses (Gross, 2001).

Previous work by Gross and John (2003) found more experience and expression of positive emotions and less experience and expression of negative emotions associated with reappraisal; conversely, suppression was linked to decreased experience and expression of positive emotion but not experience of negative emotion (Gross & John, 2003). Consistent with these findings, reappraisal has been associated with multiple adaptive outcomes, including enhanced performance on aptitude tests among college students (Jamieson, Mendes, Blackstock, & Schmader, 2010), as well as significantly less anxiety and depression (Aldao et al., 2010). Moreover, studies have found suppression to be linked to psychopathy (e.g., anxiety, depression, disordered eating, schizophrenia; Aldao & Nolen-Hoeksema, 2010; Joormann & Gotlib, 2010; Kimhy et al., 2012) and lower self-esteem (Nezlek & Kuppens, 2008).

1.1. Emotion regulation and substance outcomes

Evidence suggests CBT for substance use disorders (CBT-SUD) is efficacious for alcohol and SUDs (Magill & Ray, 2009; see McHugh, Hearon, & Otto, 2010). Indeed, meta-analytic approaches have demonstrated significant effects of cognitive-behavioral therapy ([CBT]; including cognitive restructuring, which involves reappraisal) in treating substance use problems, particularly cannabis (Magill & Ray, 2009). On the other hand, previous research has found that suppression negatively affects treatment outcomes, including smoking cessation efforts (e.g., Toll, Sobell, Wagner, & Sobell, 2001). Further, prior research has also found increased substance use (i.e., smoking) associated with attempts to suppress alcohol consumption urges (Palfai, Monti, Colby, & Rohsenow, 1997). Thus, consistent with the process model of emotion regulation, the literature indicates use of reappraisal associated with adaptive substance-related outcomes (e.g., treatment success), whereas suppression is linked to maladaptive substance-related outcomes (e.g., increased urges to use, treatment interference).

1.2. Substance-related protective behavioral strategies

Given these prior findings, there is a paucity of research examining the links between these two ER strategies and a type of adaptive substance-related behaviors referred to as protective behavioral strategies (PBS). As reviewed by Pearson (2013), PBS are behaviors individuals engage in to moderate consumption of substances and/or to reduce negative consequences associated with substance use. Three primary PBS have been identified for alcohol use (Martens et al., 2005): Stopping/Limiting Drinking (e.g., put extra ice in your drink), Manner of Drinking (e.g., avoid drinking games), and Serious Harm Reduction (e.g., use a designated driver). More recent work (e.g., Pedersen, Huang, Dvorak, Prince, & Hummer, 2017; Pedersen, Hummer, Rinker, Traylor, & Neighbors, 2016) has begun to examine overall cannabis-specific PBS. Clinically, PBS are often used in brief, harm-reduction focused interventions (e.g., Kulesza, McVay, Larimer, & Copeland, 2013; Larimer et al., 2007), with newer interventions focusing exclusively on increasing PBS use (e.g., Dvorak, Pearson, Neighbors, & Martens, 2015). Although much work links PBS and substance-related outcomes (see Bravo, Anthenien, et al., 2017; Bravo, Prince, et al., 2017; Pearson, 2013), as well as substance use risk factors (e.g., poor self-control, as measured by Present Time Perspective, Poor Delay of Gratification, and Distractibility; Pearson, Kite, & Henson, 2013), associations between ER strategies and PBS have yet to be examined.

1.3. Current study

Thus, the purpose of this study is threefold: First, an examination of the ERQ factor structure was conducted. Notably, the ERQ is often used in psychopathology and treatment research, including to assess treatment outcomes in dialectical behavior therapy (e.g., Navarro-Haro et al., 2018; see Neacsiu, Rizvi, Vitaliano, Lynch, & Linehan, 2010) and other interventions (e.g., yoga for women with posttraumatic stress disorder; Dick, Niles, Street, DiMartino, & Mitchell, 2014). As such, support for the ERQ's psychometric soundness is warranted. To our knowledge, only one previous study has examined the factor structure of the ERQ using confirmatory factor analyses and tests of measurement invariance (see Spaapen, Waters, Brummer, Stopa, & Bucks, 2014) using community samples from Australia and the United Kingdom. However, factor structure and measurement invariance tests of the ERQ have not been examined in United States samples.

The second aim of the current study is to assess relations between ER strategies and substance use outcomes (i.e., alcohol and cannabis use, PBS, and use-related problems). To our knowledge, we are the first to examine how specific emotion regulation strategies may influence PBS use. Given the literature suggests reappraisal is associated with more adaptive behaviors, whereas suppression is associated with maladaptive behaviors, we hypothesized a negative relation between reappraisal and substance use (i.e., binge drinking and cannabis use) and use-related problems, as well as a positive association between reappraisal and use of PBS. We expected opposite relations for suppression.

Third, we sought to examine whether ER strategies and PBS use interact to predict substance use, as well as related problems. Indeed, previous work has demonstrated significant interactions between PBS use and substance use motives (e.g., using for social or coping purposes), which differentially relate to alcohol and cannabis use outcomes (see Bravo, Anthenien, Prince, & Pearson, 2017; Patrick, Lee, & Larimer, 2011; c.f., Pearson, Prince, & Bravo, 2017). Because motives are thought to be driven by emotional regulatory needs (e.g., increasing positive affect and decreasing negative affect), it may be that emotion regulation strategies also interact with PBS to yield different outcomes. Moreover, previous work has noted significant interactions between PBS use and sex in predicting use, such that females with very high PBS use also report higher cannabis use frequency (see Bravo, Anthenien, et al., 2017). As such, we examined these ER strategy relations to substance-related outcomes, including potential interactions with PBS use, separately by sex.

2. Material and methods

2.1. Participants and procedure

Participants (*N* = 643 who self-identified as 64% women, 67% White, 15% Hispanic/Latinx) consisted of undergraduate students taking introductory psychology courses from a large, southwestern university. Participants completed a battery of self-report measures and demographics online and were compensated with research credit. All procedures and measures were approved by the university's Institutional Review Board.

2.2. Measures

2.2.1. Emotion regulation

The Emotion Regulation Questionnaire (Gross & John, 2003), a 10-item measure of reappraisal and suppression on a 7-point Likert-type scale was used. Six items assess reappraisal (e.g., "I control my emotions by changing the way I think about the situation"; "When I'm faced with a stressful situation, I make myself think about it in a way that helps me stay calm"). Four items are used to assess suppression (e.g., "I control my emotions by not expressing them"; "When I am feeling

negative emotions, I make sure not to express them").

2.2.2. Substance use

Items recommended by the National Institute of Alcohol Abuse and Alcoholism were modified to assess past two-week drinking quantity, frequency, and binging (National Institute of Alcohol Abuse and Alcoholism, n.d.). Lifetime and past 30-day cannabis use were also assessed. Number of binge drinking episodes in the past two weeks (ordinal) and past 30-day cannabis use (binary) were outcome variables in the current study.

2.2.3. Substance-specific protective behavioral strategies

Alcohol-specific PBS were assessed using the Protective Behavioral Strategies Scale – 20 (PBSS-20; Treloar, Martens, & McCarthy, 2015), which consists of 20 items on a 5-point Likert-type scale, ranging from 0 (*never*) to 4 (*always*). This scale assesses three types of PBS: Stopping/Limiting Drinking, Manner of Drinking, and Serious Harm Reduction. The 17-item Protective Behavioral Strategies Scale for Marijuana – short form (Pedersen et al., 2017) was used to assess overall cannabis-specific PBS use on a 6-point Likert-type scale, ranging from 0 (*never*) to 5 (*always*). Both have demonstrated at least partial scalar invariance across gender (Pedersen et al., 2017; Treloar et al., 2015).

2.2.4. Substance-related problems

The *Diagnostic and Statistical Manual of Mental Disorders, 5th edition* (*DSM-5*; American Psychiatric Association, 2013) criteria for alcohol and cannabis use disorders (i.e., 13 binary items consisting of the 11 criteria with two items for each tolerance and withdrawal criteria) were used. Substance-related problems were calculated by summing these responses.

2.3. Analytic procedure

Individuals who self-reported no lifetime alcohol ($n = 37$) or cannabis use ($n = 266$) were removed prior to alcohol and cannabis analyses, respectively. Measurement models were first constructed for all latent variables. Response options were collapsed as necessary to ensure each response option had a minimum of 15 observations when possible, resulting in 4–6 response options for the ERQ items, 4–5 for the PBSS-20, 3–6 for the PBSM, and 8 response options for past two-week binge drinking items[2] (see Agresti, 2013 for assumptions of ordinal variables). All structural equation modeling was completed in Mplus version 7.11 (Muthén & Muthén, 1998-2012). All variables were modeled as categorical with a weighted least squares means and variances (WLSMV) estimator, and listwise deletion was used for missing data.

Structural equation modeling was then used to examine main effects of ER strategies on substance use outcomes (i.e., PBS use, substance use, and substance-related problems). These models were then examined for females and males, separately, as other scales were not tested for invariance. Latent variable interactions (i.e., ER strategies and PBS predicting use and related problems) were examined using the XWITH command in Mplus with standardized latent predictors and maximum likelihood estimation with robust standard errors.

3. Results

3.1. Emotion regulation questionnaire

The ERQ did not fit the data based on chi-square and RMSEA. Inspection of the standardized factor loadings indicated one

suppression item (i.e., "When I am feeling positive emotions, I am careful not to express them") did not adequately load onto the latent variable ($\lambda = 0.33$). After removal, model fit improved (i.e., CFI = 0.97, RMSEA = 0.08). Measurement invariance testing demonstrated both subscales to be invariant across sex (Reappraisal DIFFTEST $\chi^2(20) = 29.64$, $p = .08$; Suppression DIFFTEST $\chi^2(16) = 21.46$, $p = .16$).[3] For descriptive statistics and correlations, see Tables 1 and 2. See Table 3 for model fit.

3.2. Relations with substance use outcomes for females

Reappraisal was positively associated with all types of PBS use for both substances and negatively related to frequency of past two-week alcohol binges, but not past-month cannabis use or endorsement of AUD or CUD criteria.[4] Suppression was not significantly related to any outcome for females. See Table 4.

3.3. Relations with substance use outcomes for males

Reappraisal was positively associated with alcohol-specific serious harm reduction PBS and approached significance for cannabis-specific PBS use. Reappraisal was negatively related to AUD and CUD criteria endorsement, approached significance for past two-week binges, but was unrelated to past-month cannabis use. For males, suppression was positively associated with alcohol-specific serious harm reduction PBS and negatively associated with past two-week binges, AUD criteria, and approached significance for CUD criteria. See Table 4 for all standardized estimates from univariate SEMs.

3.4. Latent variable interactions

Examination of ER strategies and PBS interacting to predict use and use disorder criteria for alcohol and cannabis indicated significant latent variable interactions between reappraisal and cannabis-specific PBS in predicting past-month cannabis use and CUD criteria.[5] Results demonstrated significant interactions for males across both, past-month cannabis use (i.e., Reappraisal $b = 0.01$, $p = .99$; PBSM-short form $b = -1.16$, $p < .001$; Interaction $b = -0.95$, $p < .01$), as well as CUD criteria (i.e., Reappraisal $b = -0.47$, $p = .05$; PBSM-s $b = -0.94$, $p < .001$; Interaction $b = -0.86$, $p < .01$). These interactions indicate that, for males, those higher in reappraisal who use more cannabis-specific PBS had lower probabilities of past-month use and fewer cannabis-related problems, whereas for those low in reappraisal, more PBS was not associated with outcomes. See Figs. 1 and 2. No other significant interactions were found.

4. Discussion

The purpose of the current study was threefold: examine select psychometric properties of the Emotion Regulation Questionnaire (Gross & John, 2003), determine whether specific ER strategies were related to alcohol- and cannabis-related outcomes, and explore whether significant interactions exist between ER strategy and PBS use predicting substance use and related problems. Results indicated acceptable model fit for the ERQ and measurement invariance across sex after one item was removed from the suppression subscale. Consistent with

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[2] For number of binge drinking episodes in the past two weeks, 2 participants responded, "every day," and 9 responded, "almost every day." These responses were collapsed onto "3–5 times a week," resulting in 5 response options, ranging from 0 to 3–5 times a week.

[3] The full scale was also tested, though measurement invariance was only achieved after the suppression item was removed and the reappraisal-suppression correlation was freed across sex (DIFFTEST $\chi^2(33) = 45.90$, $p = .07$).

[4] Measurement invariance also tested and demonstrated among lifetime users for DSM-5 AUD (i.e., DIFFTEST $\chi^2(12) = 11.04$, $p = .53$) and CUD criteria ($\chi^2(12) = 16.76$, $p = .16$) across gender.

[5] Model fit indices (i.e., χ^2, CFI, RMSEA) not provided when using TYPE = RANDOM in Mplus.

Table 1
Descriptive Statistics.

Variables	Female Mean (SD)	Male Mean (SD)	Range
Reappraisal	23.38 (4.88)	23.12 (5.12)	12–33
Suppression	10.24 (3.94)	11.44 (4.06)	4–18
PBS MOD	11.18 (5.29)	9.73 (3.12)	0–20
PBS SLD	16.30 (7.27)	14.34 (7.40)	1–28
PBS SHR	28.02 (4.59)	24.91 (6.11)	7–32
TW Alcohol Binge	1.02 (1.20)	1.10 (1.29)	0–4
AUD Criteria	2.89 (3.41)	2.90 (3.40)	0–13
PBSM-s	67.05 (16.24)	61.17 (16.71)	21–85
PM Cannabis Use	117 (52%)	84 (58%)	–
CUD Criteria	1.88 (3.11)	2.76 (3.94)	0–13

Note. PBS = protective behavioral strategy; MOD = manner of drinking; SLD = stopping/limiting drinking; SHR = serious harm reduction; PM Cannabis Use = binary past-month cannabis use; TW Alcohol Binge = frequency of binge drinking in the past two weeks; AUD Criteria = DSM-5 alcohol use disorder criteria; PBSM-s = Protective Behavioral Strategies for Marijuana – short form; CUD Criteria = DSM-5 cannabis use disorder criteria. Ranges were identical across sex. Only individuals who endorsed alcohol and/or cannabis use included in Reappraisal and Suppression means. Suppression means calculated with Item 2 removed. Full subscale descriptive statistics available upon request.

Table 2
Correlations between Emotion Regulation Strategies, Protective Behavioral Strategies, and Substance Use Outcomes.

Variables	Reap	Supp	MOD	SLD	SHR	Binge	AUD	PBSM	PMC
Reappraisal									
Suppression	0.13**								
PBS MOD	0.10*	0.03							
PBS SLD	0.09*	−0.02	0.72**						
PBS SHR	0.17**	−0.01	0.55**	0.59**					
TW Binge	−0.15**	−0.08	−0.39**	−0.29**	−0.33**				
AUD Criteria	−0.09*	−0.05	−0.11	−0.06	−0.17**	0.27**			
PBSM-s	0.17**	−0.01	0.33**	0.32**	0.54**	−0.22**	−0.19**		
PM Cannabis	−0.03	0.03	−0.10	−0.09	−0.31**	0.25**	0.11	−0.29**	
CUD Criteria	−0.09	−0.05	−0.09	−0.06	−0.21**	0.14**	0.47**	−0.33**	0.18**

PBS = Protective Behavioral Strategies; MOD = Manner of Drinking (alcohol-specific); PBS SLD = Stopping/Limiting Drinking (alcohol-specific); SHR = Serious Harm Reduction (alcohol-specific); TW Binge = frequency of past two-week binge drinking episodes (ordinal); AUD Criteria = DSM-5 Alcohol Use Disorder criteria; PBSM-s = Protective Behavior Scale for Marijuana-short form; PM Cannabis/PMC = past-month cannabis use (binary); CUD Criteria = DSM-5 Cannabis Use Disorder Criteria; Correlations calculated among lifetime users of alcohol ($n = 607$), while cannabis-specific variable correlations are among lifetime cannabis users only ($n = 379$). Only individuals who endorsed lifetime alcohol and cannabis use ($n = 377$) were included for alcohol-cannabis outcome correlations. Pearson product-moment correlations reported for continuous variables (i.e., reappraisal, suppression, alcohol- and cannabis-specific protective behavioral strategies, AUD and CUD criteria). Polyserial correlations reported for ordinal-continuous correlations (e.g., past two-week binge and continuous variables). Biserial correlations reported for binary-continuous relations (e.g., past-month cannabis use and continuous variables). Polychoric correlations are reported for ordinal-binary relations (i.e., past two-week binge and past-month cannabis use).

* $p < .05$.
** $p < .01$.

Table 3
Model Fit Indices for Measurement Models.

Model	χ^2	(df)	CFI	RMSEA
ERQ	248.58*	(34)	0.95	0.10
Modified ERQ	141.06*	(26)	0.97	0.08
PBSS-20	889.60*	(167)	0.95	0.08
PBSM-s	414.66*	(119)	0.97	0.08
AUD criteria	168.04*	(65)	0.98	0.05
CUD criteria	100.02*	(65)	0.99	0.04
ERQ Reappraisal	29.64	20	0.97	0.08
ERQ Suppression	21.46	16	0.99	0.03

ERQ = Emotion Regulation Questionnaire; PBSS-20 = Protective Behavioral Strategies Scale-20; PBSM-s = Protective Behavioral Strategies for Marijuana – short form; AUD = DSM-5 alcohol use disorder criteria; CUD = DSM-5 cannabis use disorder criteria. Reappraisal and Suppression DIFFTEST χ^2 provided, along with scalar model fit.

* $p < .01$.

process model of ER theory and our hypotheses, reappraisal was negatively associated with negative alcohol-related outcomes (i.e., binge drinking and alcohol use disorder criteria), and positively associated with adaptive behaviors (i.e., use of alcohol- and cannabis-specific protective behavioral strategies), though these varied by sex. Inconsistent with our hypotheses, suppression was negatively associated with binge drinking and alcohol use disorder criteria and positively related to use of alcohol-specific serious harm reduction strategies while drinking for males. Latent variable interactions indicated those who endorsed more use of reappraisal and more cannabis-specific PBS reported fewer cannabis-related problems (i.e., CUD criteria), though this was only among men. This study provided the first examination of the ERQ's factor structure and its relation to protective behavioral strategies in a United States college sample and has several research and clinical implications.

4.1. Emotion regulation questionnaire

Our results differ from those of Spaapen et al. (2014), who also removed one item from the ERQ with a low factor loading and achieved good model fit. In the previous study, the reappraisal item "When I want to feel less negative emotion (such as sadness or anger), I change what I'm thinking about" was removed (Spaapen et al., 2014); however, this item loaded highly on our reappraisal latent variable ($\lambda = 0.67$) and is not theoretically inconsistent with the goal of reappraisal. In the current study, the suppression item, "When I am feeling positive emotions, I am careful not to express them" improved the model fit of the ERQ when removed. Previous work indicates suppression of positive emotions is atypical, as people tend to suppress expression of unwanted emotions (Gross, 2014). This item also demonstrated differential item functioning across sex. Future work using the ERQ may benefit from removing this item.

Additionally, measurement invariance was only demonstrated after the correlation between reappraisal and suppression was freed across sex. This indicates the relation between use of reappraisal and suppression significantly differs across women ($r = 0.07$, $p = .22$) and men ($r = 0.31$, $p < .001$). Speculatively, males may utilize suppression due to Western cultural pressures to behave in a traditionally masculine manner. Males may suppress physiological and/or behavioral responses to an emotion while also employing reappraisal in some contexts. In

Table 4
Standardized Estimates for SEMs.

Model	PBS MOD	PBS SLD	PBS SHR	TW Alcohol Binge	AUD Criteria	PBSM-s	PM Cannabis Use	CUD Criteria
Reappraisal	0.11*	0.11*	0.23**	−0.16**	−0.12*	0.20**	−0.03	−0.12
Female	0.13*	0.14*	0.22**	−0.17**	−0.09	0.24**	−0.03	−0.00
Male	0.07	0.05	0.24**	−0.15†	−0.16†	0.16†	−0.04	−0.23*
Suppression	0.02	−0.02	0.01	−0.09†	−0.07	−0.03	0.05	−0.07
Female	0.04	0.05	−0.03	−0.05	0.03	−0.01	0.13	−0.02
Male	0.09	−0.07	0.20**	−0.18*	−0.25**	0.03	−0.12	−0.19†

PBS = protective behavioral strategy; MOD = manner of drinking; SLD = stopping/limiting drinking; SHR = serious harm reduction; PM Cannabis Use = binary past-month cannabis use; TW Alcohol Binge = frequency of binge drinking in the past two weeks; AUD Criteria = DSM-5 alcohol use disorder criteria; PBSM-s = Protective Behavioral Strategies for Marijuana – short form; CUD Criteria = DSM-5 cannabis use disorder criteria; For alcohol-specific outcomes, $n = 607$ (i.e., $n = 393$ in female models; $n = 214$ in male models). For cannabis-specific outcomes, $n = 379$ (i.e., $n = 232$ in female models; $n = 147$ in male models).
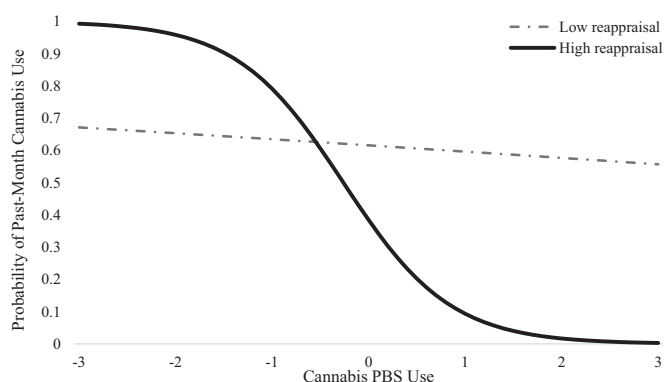
* $p < .05.$
** $p < .01.$
† $p < .10.$

Fig. 1. Past-Month Cannabis Use as a Function of Reappraisal and Cannabis PBS Use for Males.
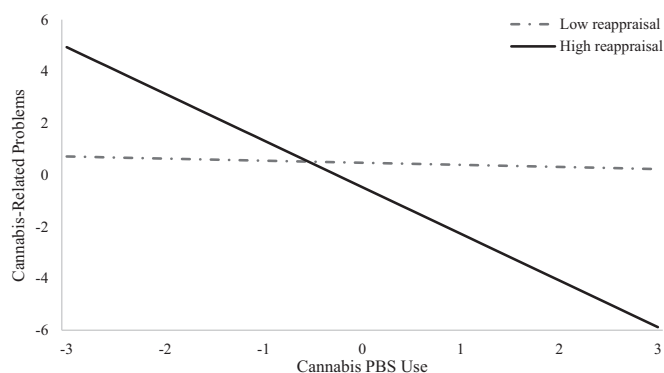

Fig. 2. Cannabis-Related Problems as a Function of Reappraisal and Cannabis PBS Use for Males.

this way males may be able to adhere to cultural expectations while regulating emotions adaptively. This is in line with accounts of regulatory flexibility, which suggests people choose specific ER strategies based on "context sensitivity, repertoire, and response to feedback—-with a particular emphasis on individual differences" (Bonanno & Burton, 2013, p. 591).

4.2. Substance-related outcomes

As expected, reappraisal was negatively associated with maladaptive alcohol outcomes. Speculatively, individuals who are regulating emotions using cognitive strategies may be less prone to drinking for emotionally-driven reasons, which has been linked to negative alcohol-related consequences and other maladaptive outcomes (Blanchard

et al., 2018; see Cooper et al., 1995; Cooper, Kuntsche, Levitt, Barber, & Wolf, 2016). Although consistent with the trend of dichotomizing ER strategies as adaptive or maladaptive, our suppression findings (i.e., correlations with PBS and consequences reflecting adaptive outcomes for males) highlight the inherent issues in this approach (i.e., fallacy of uniform efficacy; Bonanno & Burton, 2013). Going forward, a more nuanced approach is warranted to determine which emotions, when suppressed, yield better outcomes in specific contexts.

Our results suggesting reappraisal was protective, both in terms of less binge drinking (for females) and related problems (for males), as well as more use of PBS for alcohol and cannabis, may inform clinical work. Although this is speaking beyond the data, college males who are low on reappraisal may benefit from instruction on cognitive restructuring, as those high in reappraisal used PBS more effectively (i.e., used cannabis less frequently and experienced fewer consequences). Further, brief interventions for college students may benefit from incorporating emotion regulation-focused skills, in addition to PBS use, particularly for men who use cannabis and are low in reappraisal use. For example, cognitive components of CBT-SUD or DBT skills training may help reduce problematic substance use in brief interventions.

Additionally, we found that cannabis-specific PBS use was negatively associated with frequency of past two-week binges and endorsement of alcohol use disorder criteria. Similarly, alcohol-specific SHR use exhibited small-to-medium negative correlations with past-month cannabis use and cannabis use disorder criteria. This adds to the literature demonstrating cross-over effects of PBS use (e.g., Granato et al., 2018). Although more research is needed, these findings suggest the protective effects of specific types of PBS use may generalize to other forms of substance use and related consequences.

4.3. Limitations and future directions

Notable limitations of the current study include cross-sectional data and reliance on self-report measures, which prevents establishment of temporal sequencing and may not provide data as valid and reliable as interviewing, particularly for *DSM-5* use disorder criteria. Another potential limitation is the relatively small sample size of cannabis-using males (i.e., $n = 147$), though Monte Carlo simulations suggest we were likely adequately powered for most SEMs (see Wolf, Harrington, Clark, & Miller, 2013). Another limitation was the use of binary past-month cannabis use, as modern assessments typically include quantity, frequency, number of daily sessions, potency, and route of administration (e.g., Cuttler & Spradlin, 2017). Further, original question stems for PBS and ER strategy assessments were used, which do not include specified time windows, as recommended by other PBS researchers (e.g., Pearson, Kite, & Henson, 2012; Pedersen et al., 2017). Because outcomes included past-month measures, results should be interpreted in light of this limitation. Although we focused on college students due to

prevalence and risk for substance use, these findings may not be generalizable to broader substance-using populations. Nevertheless, we believe these preliminary findings provide evidence for the role of ER strategies in substance use outcomes among college students, which vary by sex.

In addition to replication efforts, further examination using an ecological momentary assessment designed to assess emotional flexibility, including emotions being regulated and context, may be most helpful in understanding these complex associations. Given recent evidence suggesting co-use of alcohol and cannabis may yield more negative consequences (Yurasek, Aston, & Metrik, 2017), future work should examine the effects of PBS and emotion regulation in these subpopulations. Because motives predict alcohol and cannabis outcomes (e.g., Buckner, 2013; Cooper et al., 1995), determining whether the specific motives interact with specific ER strategies may be useful for prevention and treatment efforts. More broadly, assuming one's drinking is motivated by emotional goals (e.g., enhancement and coping drinking motives; Cooper et al., 1995), the process model of emotion regulation may be useful for conceptualizing substance-related behaviors. For example, if one responds to a specific emotion (e.g., sadness) by using a substance, the use behavior is a form of response modulation (see Gross, 1998b). If the substance use is conceptualized as a response to the emotion, however, then PBS use could be considered a form of response modulation (e.g., taking breaks, setting limits). Alternatively, if one assumes substance use will occur (e.g., "I will drink at this party"), then PBS could be used to regulate emotions related to use (e.g., potential shame/guilt following substance-related negative consequences). Using this conceptualization, most forms of PBS could be considered situation selection (e.g., only use in specific contexts, with trusted peers) and/or situation modification (e.g., avoid shots/bongs, set limits). Thus, the process model may provide a useful framework for understanding PBS and other substance-related behaviors.

5. Conclusions

The current study aimed to determine whether reappraisal and suppression predicted substance-related behaviors. Consistent with our hypotheses, results indicated reappraisal was negatively related to past two-week binging and AUD/CUD criteria for males and was positively associated with all alcohol- and cannabis-specific PBS, though only for females. Inconsistent with our hypotheses, suppression was negatively predictive of past two-week binge drinking and AUD criteria, as well as positively predictive of alcohol-specific serious harm reduction PBS for males only. The current work also found the effectiveness of PBS in reducing cannabis use and related problems for males varied by level of reappraisal use. Although replication is necessary, these results are consistent with regulatory flexibility approaches and suggest ER strategies are important when examining alcohol- and cannabis-related behaviors among college students.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.addbeh.2018.12.020.

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