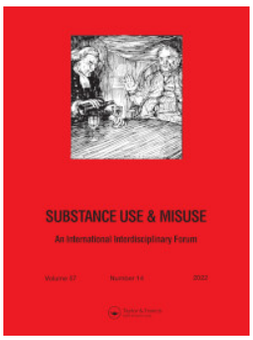

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ORIGINAL ARTICLE

The Effect of Cognitive-Affective Factors on PTSD and Alcohol Use Symptoms: An Investigation on Rumination, Suppression, and Reappraisal

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ABSTRACT

Background: Posttraumatic stress disorder (PTSD) and alcohol use disorder (AUD) are mental health conditions that often co-occur. The complexity of this comorbidity is well-documented, though the role of malleable cognitive-affective factors in PTSD/AUD warrants further study. Specifically, attaining a more comprehensive understanding of the role of malleable cognitive-affective factors in individuals with symptoms of PTSD/AUD may have important implications for future research, such as in treatment-seeking individuals. Extant examinations of cognitive-affective factors have demonstrated unique associations of cognitive reappraisal, expressive suppression, and rumination in PTSD symptom severity, though these effects had yet to be explored in subgroups of comorbid PTSD/AUD. *Methods*: In a sample of trauma-exposed individuals ($n = 334$) recruited to participate through an internet labor market, we first empirically examined latent subgroups of PTSD/AUD symptoms using latent profile analysis, then included expressive suppression, cognitive reappraisal, and four dimensions in the model to elucidate their role in specific profile patterns of PTSD/AUD symptom typologies. *Results*: Our results support a four-class model of PTSD/AUD symptoms, with unique predictive effects of expressive suppression, problem-focused thoughts, repetitive thoughts, and anticipatory thoughts on latent profile status. *Conclusions*: These findings may have important implications for future research focused on examining cognitive-affective patterns as they apply to intervention techniques in treatment-seeking individuals with symptoms of PTSD/AUD.

KEYWORDS

PTSD; alcohol use; emotion regulation; rumination; reappraisal; suppression; latent profile analysis

Introduction

Posttraumatic stress disorder (PTSD) commonly presents with elevated rates of co-occurring mental health diagnoses (Brady et al., 2000; Debell et al., 2014; Spinhoven et al., 2014), including alcohol use disorder (AUD). This comorbidity may be particularly salient as a review highlights that among individuals with PTSD prevalence of comorbid alcohol misuse can range from 10 to 61% (Debell et al., 2014). Investigations have revealed associations between emotion regulation and both PTSD (Aldao et al., 2010; Seligowski et al., 2015; Tull et al., 2016) and AUD (Aase et al., 2018; Norberg et al., 2016) independently, though the role of emotion regulatory strategies and processes in comorbid symptoms profiles is less clear. Specifically, while some research has demonstrated a significant impact of emotion regulation abilities (i.e., Gratz & Roemer's model, 2004) on the relationship between PTSD and substance use (Radomski & Read, 2016; Tripp et al., 2015; Weiss et al., 2012, 2019), few studies have examined the role of cognitively-focused emotion regulation strategies (i.e., Gross' model of emotion regulation, 1998) on this comorbidity (for review of these two emotion regulation models see Tull & Aldao, 2015; Tull et al., 2020). While complexities of comorbid PTSD/AUD are well-documented (Debell et al., 2014; McCauley et al., 2012; Stewart, 1996), there have been few examinations into the typology of these co-occurring symptoms (Contractor et al., 2019; Hawn et al., 2018), and little is known about the psychological constructs important to PTSD and AUD, such as cognitively-focused emotion regulation strategies.

Theory

Two interconnected theories, self-medication (Khantzian, 1990) and negative reinforcement (Baker et al., 2004), have offered the most support in explaining the relationship between PTSD symptoms and alcohol use. *Self-medication theory* (Khantzian, 1990, 2003) postulates that unhealthy substance use serves a functional role by providing an individual relief from PTSD symptoms and related distress. This theory has been supported (Ouimette et al., 2010) and is believed to be specifically relevant in the relationship between PTSD and AUD (for review see Hawn et al., 2020; McCauley et al., 2012; Stewart, 1996). Baker and colleagues (2004) further discussed the role of motivational processing in this cycle of negative reinforcement, highlighting that the desire to escape and avoid negative affect is a pivotal motive for unhealthy substance use. In their affective processing model of reinforcement, they described negative affect as central to withdrawal symptoms, and through repeated cycles of use and withdrawal individuals with symptoms of substance use disorder may learn to detect signs of negative affect even before those cues reach conscious awareness.

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Subsequently, they may reengage in unhealthy substance use behavior to avoid the impending affective experience. Given the elevated level of distress individuals with PTSD experience, these individuals may be particularly at perpetual risk of use via this cycle in an attempt to cope through avoidance.

PTSD and alcohol use

Across studies, associations between unhealthy alcohol use and PTSD symptom clusters have been mixed (Debell et al., 2014). In examinations using the four-factor *DSM-5* model, one study found significant correlations between all four PTSD factors and unhealthy alcohol use (Biehn et al., 2016), while another found all PTSD factors except avoidance significantly predicted alcohol misuse (Walton et al., 2018). An analysis of the PTSD Hybrid model's seven factors (Armour et al., 2015) and unhealthy alcohol use revealed significant associations between past-year alcohol use consequences and latent PTSD factors of negative affect, dysphoric arousal, and anhedonia (Claycomb Erwin et al., 2017), though there were no significant findings related to alcohol consumption. Moreover, a recent latent class analysis showed that individuals with a dysphoric typology of PTSD tended to engage in more externalizing behaviors, such as unhealthy alcohol and drug use (Byrne et al., 2019). These findings demonstrate one advantage of using latent profile analysis, as it illustrates how response patterns and relationships between symptoms may differ across individuals by examining latent subgroups. These subgroups then allow for consideration of different "typologies" of symptom presentations, which provide more detailed information than global severity and may be used to inform clinical care. To maximize the usefulness of this information, it can be important to generate this model to identify typologies of symptom patterns (e.g., high intrusive symptoms) and how those are related to other co-occurring processes (e.g., rumination). In doing so, this statistical method allows for a nuanced view of relationships among these symptoms as well as how covariates may differentially predict membership in the different typologies.

PTSD and emotion regulation

Across the literature, there is a well-established relationship between emotion dysregulation and PTSD (Seligowski et al., 2015; Tull et al., 2007, 2016). In line with Aldao and Nolen-Hoeksema (2010) findings related to mood and anxiety disorders, factors that have demonstrated strong associations with PTSD include cognitive processes of emotion regulation, such as diminished use of cognitive reappraisal, elevated levels of expressive suppression, and increased rumination. Notably, these are all cognitive response-focused strategies relevant to Gross (1998) initial conceptualization of emotion regulation. Specifically, while cognitive reappraisal is a strategy an individual may use to alter their perception of an emotionally evocative situation to change the emotional impact, with expressive suppression, an individual attempts to inhibit external cues (e.g., facial expressions) to their internal state to diminish the negative emotional state (Gross, 1998). Consistent with Gross' model (1998), cognitive reappraisal has consistently been established as a protective strategy against psychopathology, while expressive suppression has routinely been associated as a risk factor for various types of psychopathology, including substance use and PTSD (Aldao et al., 2010; Ehring et al., 2010; Moore et al., 2008).

Similarly, rumination, the repetitive focus on the experience of distress, has been conceptualized as an emotion regulation process (Aldao et al., 2010) that is strongly associated with PTSD symptoms (Seligowski et al., 2015; Seligowski & Orcutt, 2016). Recently, a meta-analysis comparing the impact of trauma-related rumination and trait rumination on PTSD symptoms found that trait rumination was a better indicator of mood and anxiety symptoms (Szabo et al., 2017). Increasingly, trait rumination is beginning to be understood as multifaceted, as evidenced by a distinct four-factor model in one widely used measure of rumination (RTSQ; Brinker & Dozois, 2009). Though the research is limited, findings on the impact of these dimensions on PTSD are mixed. For example, counterfactual thinking was found to predict *DSM-5* PTSD's intrusions and avoidance symptom clusters (Mitchell et al., 2016) and mediate the relationship between distress tolerance and these same PTSD symptom clusters (Erwin et al., 2018). However, another study found that problem-focused and anticipatory thoughts significantly mediated relationships between killing in combat and both PTSD symptoms and hazardous drinking (Kelley et al., 2020). Moreover, repetitive and anticipatory thoughts uniquely influenced the relationship between depression and PTSD symptoms (Roley et al., 2015).

Study aims and hypotheses

In an effort to clarify the relationships between these emotion regulation strategies and heterogenous patterns of PTSD and AUD symptoms, our study used mixture modeling (latent profile analysis; LPA) to empirically examine latent subgroups of individuals based on their ratings of PTSD symptoms and unhealthy alcohol use. We modeled putatively adaptive (cognitive reappraisal) and maladaptive (expressive suppression and dimensions of rumination) cognitive processes of emotion regulation as proximal covariates, as these are transdiagnostic psychological variables that are conceptually related to both PTSD symptoms and unhealthy alcohol use, as outlined above. Additionally, we modeled age and gender as covariates, as younger age and identification as a women are associated with PTSD (Karatzias et al., 2019; Tolin & Foa, 2008), and younger age and identification as a man are associated with alcohol use (Grant, 1997; Wilsnack et al., 2000). This study is important in understanding typologies of trauma-exposed individuals who are more likely to engage in unhealthy alcohol use. This inquiry allows associations of cognitive-affective factors to be tested among latent subgroups of individuals with unique symptom profiles of PTSD and unhealthy alcohol use to elucidate which factors may underlie this comorbidity. Our findings will add

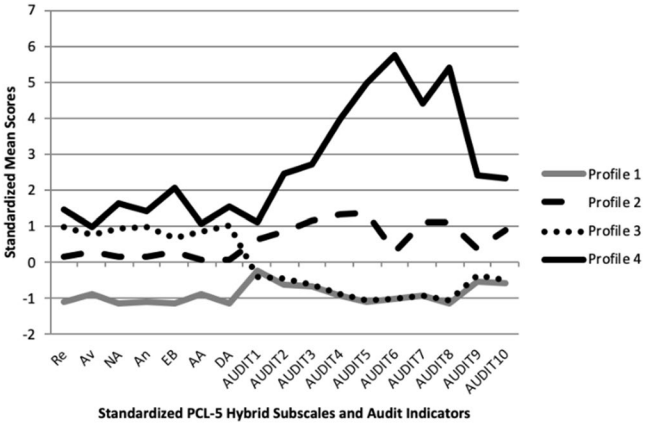

Figure 1. Latent profiles of PTSD and alcohol use symptoms.

to the theoretical understanding of the function of cognitive-affective factors in the relationship between PTSD and unhealthy alcohol use. Delineating which of these cognitive processes of emotion regulation have strong associations on the PTSD/AUD relationship can help us identify which factors may be more central to the development, maintenance, and remission of such comorbidity.

Based on prior research (Cadigan et al., 2017; Contractor et al., 2019; Hawn et al., 2018), we hypothesized a three or four profile solution would provide the best fit for the PTSD/AUD subscales using the hybrid model of PTSD. We also expected individuals reporting higher expressive suppression to belong to the more severe PTSD/AUD profile (Aldao et al., 2010; Norberg et al., 2016), and individuals reporting more use of cognitive reappraisal to be among the lowest profile of PTSD/AUD severity (Aase et al., 2018; Moore et al., 2008; Norberg et al., 2016). Finally, we anticipated greater rumination severity would predict membership in the more severe PTSD/AUD profiles, though we expected dimensions of rumination would differ in their prediction of profile memberships.

Methods

Participants and procedure

Following approval from a midwestern university's Institutional Review Board, data collected from participants recruited through Amazon's Mechanical Turk online platform in July 2015 were used for this study. Data collected via this online platform are at least as reliable as traditional data collection methods (Buhrmester et al., 2011; Shapiro et al., 2013). Further, collecting data via Mturk allows several advantages over other sampling approaches (Landers & Behrend, 2015), including a slightly more diverse sample than traditional internet or college sample methods (Buhrmester et al., 2011; Mishra & Carleton, 2017) while representing general mental health prevalence in the general population (Shapiro et al., 2013; van Stolk-Cooke et al., 2018). To qualify, participants needed to experience a traumatic event consistent with *DSM-5* Criterion A for PTSD, age ≥ 18 years, live in the United States or Canada, and have English fluency. Participants provided informed consent and were first screened for these inclusionary criteria; failing this screen redirected to a page indicating study ineligibility. Individuals who screened positive for trauma exposure (per the Stressful Life Events Screening Questionnaire, detailed below) were directed to complete the rest of the survey package. If multiple potentially traumatic events (PTEs) were reported, participants were asked to identify which event has caused them the most distress in the last month (i.e., the index trauma). In alignment with fair market compensation via Mturk at the time of data collection in 2015, each subject was compensated $0.50 for their participation in the survey, which took no longer than 30 minutes.

Of the 603 respondents initially interested in the study, 194 were routed out of the survey for not meeting trauma-exposure inclusion criteria and their data were not collected. Following data collection, we excluded 20 respondents for taking more than two standard deviations above the median active completion time; no individuals completed the survey in less than two standard deviations below the median active completion time. We also removed 14 respondents for failing embedded validity checks to ensure attentive responding, such as "what are the first three letters of the color of your eyes?" and "What is your shoe size?" assessed using free text options for string variables. Finally, we excluded 15 respondents for inattentive responding on Stressful Life Events Screening Questionnaire items (e.g., their reported age of index trauma first occurrence is older than their reported current age) and 26 for missing > 30% on at least one of the primary measures. An effective sample of 334 was used for further analyses. In this sample, individuals were between the ages of 18-74 years (M_{age}= 36.05, SD = 12.71) and mostly female (63.5%). Respondents were mostly well-educated (64.4% held an associate degree or higher), employed (66.2%), white (77.5%), and non-Hispanic (80.2%), and a notable portion were married (42.2%). On average, participants endorsed having experienced 4.6 PTEs (SD= 2.8) in their lifetime. The most commonly endorsed PTEs were sudden violent death of someone close (50.0%), physical assault (46.8%), and sexual assault (41.1%). The most prevalent worst (i.e., index) traumatic events were sudden, violent death of a close family member or friend (19.2%), life-threatening illness (15.0%), and life-threatening accident (11.4%), which are similar to those reported in other Mturk studies examining trauma-exposure and PTSD symptom severity (Contractor et al., 2017; Engle et al., 2020). Further, according to their respective psychometric cutoff scores, of the full sample of trauma-exposed individuals, 27.5% (AUDIT ≥ 8; Saunders et al., 1993) and 54.2% (PCL ≥ 33; Bovin et al., 2016) had probable alcohol use disorder and PTSD, respectively.

Instruments

Data were collected via self-report measures delivered through a secure, web-based survey format. The following previously validated measures and an additional questionnaire on demographic characteristics, such as age, gender, and racial background, were administered.

The stressful life events screening questionnaire

The Stressful Life Events Screening Questionnaire (SLESQ; Goodman et al., 1998), was used to screen respondents for lifetime trauma-exposure according to *DSM-5* PTSD's criterion A. The SLESQ is a 12-item self-report instrument which uses behaviorally specific questions to assess for lifetime exposure to a variety of Criterion A1 events as defined by *DSM-5* PTSD diagnostic criteria, and has been previously used as a screening measure for *DSM-5* Criterion A1 trauma exposure (Elhai et al., 2012; Long et al., 2008). Participants were asked to select "yes" or "no" regarding whether they have previously experienced 12 specific PTEs. The participant was then asked to select which PTE has been the most distressing over the past month and to keep this event in mind while completing the next measure (the PCL-5, see below). The SLESQ has demonstrated good reliability (κ = 0.73) and adequate convergent validity (κ = 0.64; Goodman et al., 1998).

The PTSD checklist for DSM-5

The PTSD Checklist for *DSM-5* (PCL-5; Weathers et al., 2013) is a 20-item measure developed to assess PTSD symptoms over the past month in accordance with *DSM-5* PTSD criteria. Symptoms are rated on a 5-point Likert-type scale ranging from 0 (*"not at all"*) to 4 (*"extremely"*), in which higher scores indicate more severe symptoms. Although the *DSM-5* (American Psychiatric Association, 2013) uses a four-factor model of PTSD symptoms, a seven-factor Hybrid model (Armour et al., 2015) has often resulted in superior fit above all other models in various trauma-exposed samples (Pietrzak et al., 2015; Seligowski & Orcutt, 2016; Wortmann et al., 2016). As such, in this study, the PCL-5 items will be grouped to reflect the seven subscales of this model. In recent explorations of its psychometric properties, the PCL-5 is demonstrated to be reliable and valid (Bovin et al., 2016; Wortmann et al., 2016). The current study demonstrated high internal consistency (Cronbach's α=.96; McDonald's ω = .96).

The alcohol use disorder identification test

The Alcohol Use Disorder Identification Test (AUDIT; Saunders et al., 1993) is a 10-item self-report measure that encompasses domains of alcohol consumption, drinking behavior, and alcohol-related problems and adverse reactions. Each question is rated from 0 to 4, with higher scores indicating more unhealthy alcohol use. Internal consistency of the AUDIT in the current study was excellent (Cronbach's α=.95; McDonald's ω = .95) and it has demonstrated high construct validity with other indices of drinking (Allen et al., 1997).

The emotion regulation questionnaire

Participants completed the Emotion Regulation Questionnaire (ERQ; Gross & John, 2003), a 10-item measure comprised of two subscales: cognitive reappraisal (ERQ-CR) and expressive emotional suppression (ERQ-ES). Respondents were instructed to rate their agreement with each item using a 7-point Likert scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). Scores are summed by subscale, with higher scores on each indicating higher trait suppression and reappraisal. This scale is reliable and valid in community adults (Spaapen et al., 2014). Current study internal consistency was good for both expressive suppression (α= .83; McDonald's ω = .84) and cognitive reappraisal (α= .89; McDonald's ω = .89).

The ruminative thought style questionnaire

The Ruminative Thought Style Questionnaire (RTSQ; Brinker & Dozois, 2009) is a 20-item self-report measure assessing general ruminative thinking. It utilizes a 7-point Likert scale for each item, ranging from 1 (*does not describe me at all*) to 7 (*describes me very well*). Higher scores on this measure indicate greater rumination. This measure shows excellent internal consistency (α = .95; McDonald's ω = .96), as well as good convergent validity with scales measuring similar constructs (Brinker & Dozois, 2009). An evaluation of the latent structure found four distinct factors (Tanner et al., 2013), each with varying contributions to psychological distress and coping: *Problem-Focused Thoughts* (PFT; α = .89; current study α= .90; McDonald's ω = .90), *Counterfactual Thinking* (CT; α = .87; current study α= .89; McDonald's ω = .90), *Repetitive Thoughts* (RT; α = .89; current study α= .95; McDonald's ω = .95), and *Anticipatory Thoughts* (AT; α = .71; current study α= .77; McDonald's ω =.77).

Data analyses

Most respondents were not missing any item-level data (91.77%) and no participant was missing more than 2 items (≤ 20%) on any measure. For participants with missing data, we estimated any item-level missing data using maximum likelihood (ML) procedures with the expectation-maximization algorithm (Graham, 2009) and summed responses to obtain scale scores for the PTSD Hybrid model, ERQ-CR, ERQ-ES, and all RTSQ. We conducted descriptive statistics analyses, including calculating means, standard deviations, and reliability, as well as assessing for normality and homogeneity, using SPSS v.25 (IBM Corp., 2017). Primary analyses were conducted in Mplus v.8 (Muthén & Muthén, 2017) in two stages.

First, we conducted LPA based on PTSD Hybrid model subscale scores and AUDIT items as dependent variables with maximum likelihood estimation and robust standard errors (MLR; Yuan & Bentler, 2000). To address scale measurement differences, these scores were standardized and the resulting z-scores were used in the model. We sequentially tested models beginning with one profile, and progressively added one additional profile until no significant improvement in model fit was found. Based on past research suggesting a three- or four-profile solution to be superior, we analyzed one- through five-profile models. According to recommended fit indices, the optimal profile solution would have the lowest Bayesian Information Criterion (BIC) value, lowest sample-size adjusted BIC (SSABIC), the last significant (before subsequent non-significance for a model with one additional class) Adjusted Lo-Mendell-Rubin (LMR) Likelihood Ratio Test value, higher entropy values, parsimony, and conceptual meaning ((Nylund, Asparouhov, et al., 2007; Nylund, Bellmore, et al., 2007).

After determining the best-fitting LPA solution, we examined effects of the hypothesized cognitive-affective factors

on latent profile membership by modeling them as covariates in the second stage of analyses. To accomplish this, we regressed the latent profiles on the observed predictor variables (i.e., observed subscale scores of ERQ-CR, ERQ-ES, PFT, CT, RT, and AT) by conducting multinomial logistic regression to determine the statistical association of these covariates with latent profile membership within the LPA model. This analysis was used to examine if these covariates differentially predicted class membership, not necessarily examining whether their means significantly differ from group to group. We further improved classification of the LPA model based on these covariates by using the "three-step" method (Asparouhov & Muthén, 2014), which uses posterior probabilities to estimate latent profile membership, then regresses the latent profile membership variable on the covariates while taking misclassification from posterior probabilities into account. These results highlight any significant relations with latent profile membership as a function of suppression, reappraisal, and dimensions of rumination, thus revealing the impact of each covariate in predicting profile membership. Significant demographic variables (e.g., age and gender) were also examined for their effects on profile membership. Additional profile-specific descriptive statistics (i.e., means and standard deviations) for demographic variables and primary measures are reported, providing more information to individual characteristics in each profile.

Results

Descriptive statistics

Scale correlations and reliability statistics are presented in Table 1. PTSD severity averaged 31.32. Comprehensive descriptive information of the primary measures and subscales for each latent profile and the full sample can be found in Table 2.

LPA results

Table 3 displays the model fit results for LPA models ranging from one to five latent profiles. We retained the four-profile model as this solution resulted in the last significant aLMR test, the most objective index in this table for determining best fit (Nylund, Asparouhov, et al., 2007). While BIC and SSABIC values continued to decrease in the five-profile model, this decrease leveled off precipitously and was the smallest between the four- and five-profile solutions. Figure 1 presents the corresponding profile plot. We labeled Profile 1 ($n = 149$; 44.61%) as low PTSD/AUD, Profile 2 ($n = 45$; 13.47%) as mild PTSD/moderate AUD, Profile 3 ($n = 99$; 29.64%) as moderate PTSD/low AUD, and Profile 4 ($n = 41$; 12.28%) as high PTSD/AUD.

Covariate results

Results from the three-step analysis of covariates are presented in Table 4. Men were over 3.5 times more likely to be in the high PTSD/AUD profile compared to the low PTSD/AUD profile ($B = -1.13$, $SE = 0.45$, $p = .01$) and the moderate PTSD/low AUD profile ($B = -0.93$, $SE = 0.44$, $p = .03$), respectively. Men were also more likely to be in the mild PTSD/moderate AUD profile compared to the low PTSD/AUD profile ($B = -0.75$, $SE = 0.38$, $p = .05$). There were no other significant differences for gender. Similarly, younger age was predictive of membership in the mild PTSD/moderate AUD profile compared to both the low PTSD/AUD profile ($B = 0.94$, $SE = 0.01$, $p < .01$) and the moderate PTSD/low AUD profile ($B = 0.96$, $SE = 0.02$, $p = .01$). There were no other statistically significant predictive differences in age.

After controlling for age and gender, expressive suppression was a significant predictor of the moderate PTSD/low AUD profile ($B = 0.09$, $SE = 0.04$, $p = .02$) and high PTSD/AUD profile ($B = 0.14$, $SE = 0.05$, $p < .01$) versus the low PTSD/AUD profile. There were no other significant differences in expressive suppression between profiles. There were no significant differences in cognitive reappraisal between any of the four profiles.

Some dimensions of rumination were predictive of profile membership after adjusting for other covariates. The high PTSD/AUD profile reported more problem-focused thoughts than every other profile ($Bs = 0.18$-0.26, $SEs =$

Table 1. Full sample primary measures and subscales' intercorrelations, reliability coefficients, and descriptive statistics.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.
1. PCL-5 Total	(.96)														
2. Reexperiencing	.90**	(.90)													
3. Avoidance	.77**	.71**	(.85)												
4. Negative Affect	.90**	.73**	.63**	(.84)											
5. Anhedonia	.86**	.68**	.55**	.75**	(.90)										
6. Externalizing Behavior	.83**	.67**	.51**	.74**	.74**	(.75)									
7. Anxious Arousal	.80**	.69**	.56**	.64**	.60**	.64**	(.88)								
8. Dysphoric Arousal	.85**	.70**	.62**	.67**	.73**	.72**	.68**	(.81)							
9. AUDIT-10	.46**	.40**	.31**	.45**	.38**	.53**	.30**	.38**	(.95)						
10. Expressive Suppression	.33**	.27**	.25**	.31**	.34**	.31**	.22**	.26**	.34**	(.83)					
11. Cognitive Reappraisal	.06	.07	.11	.07	.03	-.02	.07	-.01	.14**	.25**	(.89)				
12. Problem-Focused Thoughts	.58**	.50**	.50**	.56**	.48**	.52**	.47**	.51**	.42**	.29**	-.02	(.90)			
13. Counterfactual Thinking	.46**	.37**	.36**	.45**	.39**	.38**	.39**	.36**	.27**	.24**	.12*	.66**	(.89)		
14. Repetitive Thoughts	.45**	.39**	.35**	.39**	.39**	.32**	.44**	.40**	.17**	.08	.01	.61**	.72**	(.95)	
15. Anticipatory Thoughts	.46**	.39**	.34**	.45**	.37**	.38**	.40**	.36*	.32**	.21**	.13*	.70**	.71**	.67**	(.77)

Note. PCL-5= PTSD Checklist for DSM-5; AUDIT-10= Alcohol Use Disorder Identification Test-10.
Coefficient alpha values reported in parentheses on the diagonal.
*$p < .05$; **$p < .001$.

Table 2. Descriptive information on primary measures for the entire sample and each latent profile.

	Full Sample ($n = 334$)		Low PTSD/AUD ($n = 149$)		Mild PTSD and Moderate AUD ($n = 45$)		Moderate PTSD and Low AUD ($n = 99$)		High PTSD/AUD ($n = 41$)	
Mean (SD)										
Age	36.05	(12.71)	39.60	(13.87)	30.67	(6.90)	35.14	(12.51)	31.24	(9.56)
PCL-5 Total	31.32	(20.43)	13.56	(9.64)	34.02	(15.17)	46.72	(11.50)	55.67	(13.28)
Reexperiencing	7.99	(5.48)	3.83	(3.43)	8.58	(4.30)	11.70	(4.10)	13.53	(3.84)
Avoidance	3.77	(2.47)	2.09	(1.86)	4.35	(1.94)	5.24	(2.10)	5.66	(1.78)
Negative Affect	5.92	(4.52)	2.43	(2.46)	6.38	(3.72)	8.90	(3.43)	10.93	(3.19)
Anhendonia	4.64	(3.81)	1.76	(2.31)	5.04	(2.76)	7.25	(3.16)	8.38	(2.41)
Externalizing Behavior	2.49	(2.35)	0.73	(1.03)	2.96	(1.98)	3.60	(2.01)	5.71	(1.50)
Anxious Arousal	3.22	(2.71)	1.43	(1.96)	3.31	(2.45)	4.95	(2.28)	5.44	(1.78)
Dysphoric Arousal	3.23	(2.60)	1.30	(1.48)	3.41	(2.20)	5.09	(2.02)	6.02	(1.59)
AUDIT-10	6.33	(7.82)	2.40	(2.21)	11.31	(2.87)	2.67	(2.35)	24.02	(5.41)
Cognitive Reappraisal	28.72	(7.05)	28.90	(6.53)	27.38	(5.54)	28.00	(8.15)	31.26	(7.04)
Expressive Suppression	16.23	(5.80)	14.56	(5.52)	16.56	(4.65)	16.70	(5.98)	20.79	(4.86)
Problem-Focused Thoughts	17.08	(8.07)	13.03	(6.44)	18.24	(5.42)	19.36	(7.99)	25.00	(6.89)
Counterfactual Thinking	17.39	(6.91)	14.57	(6.91)	18.19	(5.15)	19.83	(6.64)	20.90	(5.08)
Repetitive Thoughts	18.87	(6.92)	16.08	(7.12)	19.04	(5.08)	22.32	(6.04)	20.51	(5.61)
Anticipatory Thoughts	8.30	(3.47)	6.85	(3.33)	9.29	(2.69)	9.15	(3.46)	10.39	(2.63)
n (% within column)[a]										
Gender										
Female	212	(63.5%)	102	(68.5%)	24	(53.3%)	70	(70.7%)	16	(39.0%)
Male	121	(36.2%)	46	(30.9%)	21	(46.7%)	29	(29.3%)	25	(61.0%)

Note. PTSD = posttraumatic stress disorder symptoms; AUD = alcohol use disorder symptoms; PCL-5= PTSD Checklist for DSM-5; AUDIT-10= Alcohol Use Disorder Identification Test-10.
[a]All reported percentages are valid percentages to account for missing data.

Table 3. Latent profile analysis model fit results.

Model	AIC	BIC	SSABIC	Entropy	Adjusted Lo-Mendell -Rubin (p)	BLRT p value
1 profile	16164.44	16294.02	16186.17			
2 profile	13268.16	13466.34	13301.39	.99	2904.51 (p <.01)	<.01
3 profile	12296.13	12562.91	12340.87	.94	998.65 (p <.01)	<.01
4 profile	**11751.20**	**12096.58**	**11817.44**	**.96**	**565.530 (*p* < .05)**	**<.01**
5 profile	11380.56	11784.54	11448.30	.97	413.31 (p = .12)	<.01

Note. AIC = Akaike information criterion; BIC = Bayesian information criterion; SSABIC = sample-size adjusted BIC; BLRT = bootstrapped likelihood ratio test.
Bolded values indicated the optimal model chosen for further analyses.

Table 4. Results of logistic multinomial regression analyses.

	Low PTSD/AUD vs. Mild PTSD and Moderate AUD[#]	Low PTSD/AUD vs. Moderate PTSD and Low AUD[#]	Mild PTSD and moderate AUD vs. Moderate PTSD and Low AUD[#]	High PTSD/AUD vs. Low PTSD/ AUD[#]	High PTSD/AUD vs. Mild PTSD and Moderate AUD[#]	High PTSD/AUD vs. Moderate PTSD and Low AUD[#]
OR [95% CI]						
Expressive Suppression	0.934$^{p=.068}$ [0.866, 1.008]	**0.910*** **[0.844, 0.982]**	0.975 [0.901, 1.055]	**1.152**** **[1.048, 1.267]**	1.076 [0.984, 1.178]	1.049 [0.963, 1.143]
Cognitive Reappraisal	1.033 [0.976, 1.094]	1.018 [0.945, 1.086]	0.985 [0.931, 1.042]	1.023 [0.948, 1.102]	1.057 [0.991, 1.126]	1.041 [0.973, 1.113]
Problem-Focused Thoughts	0.942 [0.873, 1.018]	**0.931*** **[0.877, 0.978]**	0.987 [0.920, 1.060]	**1.291***** **[1.170, 1.425]**	**1.217***** **[1.099, 1.348]**	**1.202***** **[1.095, 1.320]**
Counterfactual Thinking	1.036 [0.936, 1.146]	1.007 [0.935, 1.085]	0.973 [0.877, 1.079]	0.964 [0.863, 1.052]	0.999 [0.874, 1.142]	0.971 [0.872, 1.082]
Repetitive Thoughts	1.010 [0.927, 1.101]	**0.852**** **[0.777, 0.935]**	**0.843***** **[0.764, 0.931]**	0.929 [0.820, 1.052]	0.938 [0.823, 1.070]	**0.792***** **[0.700, 0.895]**
Anticipatory Thoughts	**0.808*** **[0.660, 0.989]**	1.015 [0.869, 1.185]	**1.256**$^{p=.054}$* **[1.021, 1.546]**	1.071 [0.845, 1.357]	0.865 [0.659, 1.135]	1.087 [0.865, 1.365]
Identified Gender	**2.122*** **[1.002, 4.498]**	1.221 [0.574, 2.594]	0.575$^{p=.067}$ [0.261, 1.266]	**0.323***** **[0.133, 0.786]**	0.685 [0.267, 1.755]	**0.394***** **[0.167, 0.929]**
Age	**1.060***** **[1.030, 1.092]**	1.019 [0.988, 1.050]	**0.961*** **[0.930, 0.992]**	0.958 $^{p=.055}$ [0.917, 1.002]	1.016 [0.972, 1.063]	0.976 [0.932, 1.022]

Note. PTSD = posttraumatic stress disorder symptoms; AUD = alcohol use disorder symptoms; OR = odds ratio; CI = confidence interval.
Low PTSD/AUD = Class 1; Mild PTSD and Moderate AUD = Class 2; Moderate PTSD and Low AUD = Class 3; High PTSD/AUD = Class 4.
*p<.05; **p<.01; ***p<.001.
[#]the reference class.
Bolded text indicates statistically significant values.

0.04-0.05, all *ps* < .01). Additionally, problem-focused thoughts were predictive of the moderate PTSD/low AUD profile ($B = 0.07$, $SE = 0.03$, $p = .02$) compared to the low PTSD/AUD profile. Repetitive thoughts were predictive of the moderate PTSD/low AUD profile compared to all other profiles (*Bs*= 0.16-0.23, *SEs*= 0.05-0.06, all *ps* ≤ .01). Anticipatory thoughts were significantly predictive of the mild PTSD/moderate AUD profile over the low PTSD/AUD profile ($B = 0.21$, $SE = 0.10$, $p = .04$) and the moderate PTSD/low AUD profile ($B = 0.23$, $SE = 0.11$, $p = .03$). There were no significant differences in anticipatory thoughts between the low PTSD/AUD profile and the moderate PTSD/low AUD profile, or between the high PTSD/AUD profile and any other profile. There were no significant differences in counterfactual thinking between any of the latent profiles.

Discussion

The present study findings further improve our understanding of the relationship of co-occurring symptoms of PTSD and alcohol use disorder. Our first hypothesis was supported, as we found four meaningful subgroups characterized by (a) low PTSD symptoms and low AUD symptoms, (b) mild PTSD symptoms and moderate AUD symptoms, (c) moderate PTSD symptoms and low AUD symptoms, and (d) high PTSD symptoms and high AUD symptoms. While previous examinations of item-level PTSD symptoms and common comorbidities have yielded a best-fitting three-class solution (Byrne et al., 2019; Contractor et al., 2015), including a recent examination of PTSD symptoms and substance use typologies (Contractor et al., 2019), our study is the first to model PTSD symptoms using the seven-factor Hybrid model subscales, which may account for the difference in the optimal number of classes in the model. Further, while Contractor et al. (2019) focused primarily on consumption (i.e., frequency, amount, and binging), our study modeled comprehensive symptoms of unhealthy alcohol use in addition to alcohol consumption (e.g., drinking behaviors and alcohol-related problems). Moreover, our findings are consistent with some latent class examinations of alcohol use (Cadigan et al., 2017; Hawn et al., 2018), which additionally found class differences in PTSD symptoms and trauma type among their three classes.

Our study used a person-centered approach to examine the effects of some of the previously noted individual-level differences across the four-profile solution. In doing so, we found that men in our study were more likely to be found in the profile characterized by moderate or high AUD compared to either of the low AUD profiles, suggesting gender may be related to increased unhealthy alcohol use. This finding aligns with the well-established relationship between gender and alcohol use (Nolen-Hoeksema, 2004; Wilsnack et al., 2000). Moreover, as there was no significant difference between the mild PTSD/moderate AUD profile and the high PTSD/AUD profile, this gender difference seemed unrelated to PTSD symptom severity. Similarly, younger age tended to be related to more severe alcohol use, consistent with previous findings (Grant, 1997), though our results were mixed, which may be accounted for by the relation of age to PTSD symptoms severity (i.e., more severe symptoms are typical in younger individuals; Konnert & Wong, 2015).

Of note, our four-profile solution had construct validity, demonstrated by unique associations with various processes of emotion regulation. Our second hypothesis was supported, as expressive suppression was elevated in higher-severity profiles. Importantly, our results illustrate this cognitive-affective factor may be more related to elevated PTSD symptom severity than unhealthy alcohol use, as the class differences in expressive suppression were significant between the low PTSD symptom profile and the profiles with moderate or high PTSD symptoms; there were no significant differences among any other profiles with varying PTSD and AUD symptom severity. These findings are consistent with the literature on expressive suppression and PTSD (Moore et al., 2008; Seligowski et al., 2015).

In contrast, cognitive reappraisal did not significantly differ among the profiles, inconsistent with our third hypothesis. Our sample endorsed levels of cognitive reappraisal similar to other studies examining this construct in relation to PTSD (Boden et al., 2012; Moore et al., 2008). While cognitive reappraisal is typically conceptualized as a protective factor against psychopathology such as PTSD, it is known to be context-dependent (Aldao et al., 2013). Without knowing the context of the use of reappraisal, it is difficult to determine how useful cognitive reappraisal is in effectively regulating a person's emotional experience. It has also been found to interact with emotional clarity in order to enhance an individual's attention to emotion (Boden et al., 2012). Therefore, while individuals in our sample may be reappraising to similar degrees, the context and efficacy of their reappraisal in reducing PTSD-related distress may differ, and additional emotional awareness training may augment their reappraisal strategies.

Our fourth hypothesis was partially supported, as some dimensions of rumination differentially predicted profile membership. Study results highlight that problem-focused thoughts are heightened in the high PTSD/AUD profile individuals compared to all other profiles, and in the moderate PTSD/mild AUD profile compared to the low PTSD/AUD profile, suggesting they may be more related to PTSD than AUD symptoms. This unique relation with PTSD symptoms may be attributed to the common dysfunctional beliefs and lack of perceived control prevalent in PTSD (Dunmore et al., 1999), as these individuals may then try to regain control by ineffectively ruminating on solutions to a perceived problem. Likewise, repetitive thoughts predicted membership in the moderate PTSD/low AUD profile compared to all others. While these findings suggest unique associations primarily between repetitive thoughts and PTSD symptoms, repetitive thoughts are less common in individuals with high PTSD/AUD than those with moderate PTSD/low AUD, suggesting an inverse relationship with elevated alcohol use and repetitive thoughts. In regard to both dimensions, it is plausible that decreasing problem-focused and repetitive thoughts may impact PTSD symptom severity and have secondary effects on drinking to cope motives (Caselli et al., 2010). However, it should be noted that these findings are the result of small

subgroup comparisons, and further research is needed to better understand these unexpected findings.

Our results found anticipatory rumination was highest in the mild PTSD/moderate AUD profile compared to both the low PTSD/AUD profile and the moderate PTSD/low AUD profile. These findings suggest unique associations between anticipatory thoughts and unhealthy alcohol use, though these associations no longer exist when the individual also has elevated PTSD symptoms (i.e., the high PTSD/AUD class). One potential explanation for this could be that by engaging in anticipatory thoughts, an individual may be attempting to avoid experiencing the feelings that uncertainty of future events may bring forth. As these exploratory findings were the result of small subgroups, again we call for further research to better understand these patterns. Similarly, individuals who engage in more unhealthy alcohol use have been found to more often engage in this type of experiential avoidance (Levin et al., 2012). Surprisingly, there were no profile differences in counterfactual thinking. This finding is discrepant from previous studies, which suggest that heightened counterfactual thinking is related to elevated PTSD symptom severity (El Leithy et al., 2006; Erwin et al., 2018; Mitchell et al., 2016); however, these studies did not include effects of alcohol use. As our profiles were modeled by responses to PTSD and AUD symptoms, our results suggest that counterfactual thinking may be diffusely distributed amongst these profiles, and may be more homogenous when considering additional factors, such as alcohol use.

This study addresses a research question of clinical and public health importance given the high rate of comorbidity between PTSD and AUD, as well as the clinical complications that often accompany this comorbidity. By delineating the impact of various cognitive processes of emotion regulation common to both diagnoses, our findings may assist clinicians in improving evidence-based treatment approaches for individuals with comorbid PTSD and AUD symptoms by elucidating novel intervention targets. Specifically, our results suggest unique impacts of cognitive-affective factors, which may warrant implementing emotion regulation targets to improve efficacy of interventions.

These findings and implications must be considered in light of several limitations. First, given our data collection method, our data were self-report and cross-sectional in nature, so all findings are restricted to the individual's awareness and reporting of their symptoms at that moment in time. As our respondents were mostly White, non-Hispanic individuals, our results may not generalize to nonwhite individuals. Additionally, as we did not conduct clinical interviews, we cannot report on diagnostic status of PTSD or AUD, or other common comorbidities such as depression. Further, lack of longitudinal data precludes any interpretation of causal link amongst any of the variables examined and examination of the directional link between PTSD and AUD symptoms. As such, these findings should be replicated using clinical interviews, ideally with a longitudinal design across diverse cultural groups.

Nonetheless, our study achieved its stated aims to investigate the patterns among individuals with PTSD and AUD symptoms and to explore how transdiagnostic cognitive-affective factors may function in this complex comorbidity. Future research may expand upon these findings to investigate a causal link amongst these factors. Our findings warrant additional study into mechanisms that may reduce these cognitive-affective factors, particularly the ones that are implicated with more severe PTSD and AUD symptoms.

Declaration of interest

The authors declare that they have no conflict of interest. The authors alone are responsible for the content and writing of the article.

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