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A prospective investigation of emotion dysregulation as a moderator of the relation between posttraumatic stress symptoms and substance use severity

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Abstract

Despite strong evidence for an association between the experience of posttraumatic stress (PTS) symptoms and substance use, little is known about the particular individuals most at risk for problematic substance use in response to PTS symptoms. Consequently, the goal of this study was to conduct a prospective investigation of the moderating role of emotion dysregulation (assessed through self-report and behavioral measures) in the relation between PTS symptoms and substance use 8 months later within a sample of 106 young adult women. No main effect of PTS symptoms on substance use was found. Instead, PTS symptoms were associated only with later substance use in the context of heightened emotion dysregulation. Results provide support for emotion dysregulation as a key factor that may increase risk for substance use among women experiencing PTS symptoms

and highlight a target for future interventions aimed at reducing risk for the development of maladaptive behaviors stemming from PTS symptoms.

Keywords: emotion regulation, longitudinal, moderation, posttraumatic stress disorder, self-medication, trauma

1. Introduction

It is well documented within the empirical literature that the experience of posttraumatic stress (PTS) symptoms (e.g., intrusive thoughts and memories, avoidance behaviors, emotional numbing, hyperarousal) following exposure to a traumatic event is associated with more severe substance use patterns (see Brady, Back, & Coffey, 2004; Jacobsen, Southwick, & Kosten, 2001). Specifically, prospective, epidemiological, and daily monitoring studies have shown that PTS symptoms are associated with increased likelihood of substance use and substance use disorders (e.g., Chilcoat & Breslau, 1998; Haller & Chassin, 2013; Kaysen et al., 2014; Leeies, Pagura, Sareen, & Bolton, 2010; Simpson, Stappenbeck, Luterek, Lehavot, & Kaysen, 2014). Experimental studies have also demonstrated that exposure to trauma-related reminders is associated with increased cravings for substances (Coffey et al., 2002; Saladin et al., 2003; Tull, Kiel, McDermott, & Gratz, 2013) and increased attentional bias for substance-related cues (Tull, McDermott, Gratz, Coffey, & Lejuez, 2011). Furthermore, there is evidence that the severity of negative affect experienced in response to trauma-related cues is predictive of craving intensity and the level of attentional bias to substance-related cues (Tull et al., 2011; Tull, Kiel et al., 2013). Together, these findings suggest the presence of a functional relationship between PTS symptoms and substance use, such that substances may be used to alleviate either PTS symptoms themselves or the heightened emotional distress associated with the experience of PTS symptoms, consistent with both the self-medication (Khantzian, 1997; Stewart, 1996) and negative reinforcement models of substance use, respectively (Baker, Piper, McCarthy, Majeskie, & Fiore, 2004; McCarthy, Curtin, Piper, & Baker, 2010).

Yet, despite strong evidence for an association between PTS symptoms and substance use, moderators of this relation remain unclear, and little is known about the particular

individuals most at risk for problematic substance use in response to PTS symptoms. Research in this area could aid in the development of targeted prevention efforts aimed at reducing risk for the development of problematic substance use patterns among individuals experiencing PTS symptoms following exposure to a traumatic event. One particularly relevant moderating factor that may be worth investigating in this regard is emotion dysregulation. As defined here, standing of emotions, nonacceptance or avoidance of emotions, an unwillingness to experience negative emotions as part of pursuing desired goals, difficulties controlling behaviors in the face of emotional distress, and deficits in the modulation of emotional arousal, including a lack of access to effective strategies for modulating the intensity or duration of emotions (for reviews, see Gratz & Roemer, 2004; Gratz & Tull, 2010).

Studies within both nonclinical (e.g., college students, community samples) and clinical samples have consistently found that PTS symptoms are associated with greater emotion dysregulation (Bardeen, Kumpula, & Orcutt, 2013; Ehring & Quack, 2010; McDermott, Tull, Gratz, Daughters, & Lejuez, 2009; Tull, Barrett, McMillan, & Roemer, 2007; Weiss, Tull, Anestis, & Gratz,2013). In addition, numerous studies provide support for the theorized emotion regulating function of substance use among individuals experiencing symptoms of PTS. For example, Waldrop, Back, Verduin, and Brady (2007) found that substance dependent patients with (vs. without) posttraumatic stress disorder (PTSD)were more likely to use substances in response to unpleasant emotions. Further, alcohol use coping motives have been found to mediate the association between PTS symptoms and alcohol problems (Kaysen et al., 2007; Ullman, Filipas, Townsend, & Starzinski, 2005; Yeater, Austin, Green, & Smith, 2010), and Bonn-Miller, Vujanovic, Boden, and Gross (2011) found that emotion dysregulation explained the association between PTS symptom severity and marijuana use coping motives. Emotion dysregulation has also been implicated in other impulsive behaviors among individuals experiencing PTS symptoms. Specifically, Weiss, Tull, Viana, Anestis, and Gratz (2012) demonstrated that emotion dysregulation accounted for the association between PTSD and engagement in a variety of impulsive behaviors within a sample of substance dependent patients. This research suggests the central role of

emotion dysregulation in substance use among individuals experiencing PTS symptoms. In particular, given that the experience of PTS symptoms is associated with heightened negative emotional arousal (Orsillo, Batten, Plumb, Luterek, & Roessner, 2004), the presence of emotion dysregulation among individuals with these symptoms may increase motivation to engage in maladaptive behaviors, such as substance use, in order to quickly alleviate or escape emotional distress.

Unfortunately, one limitation of the extant research in this area is the almost exclusive reliance on cross-sectional designs, which limits conclusions regarding the temporal relations amongst PTS symptoms, emotion dysregulation, and substance use. In addition, most studies in this area have used only self-report measures of emotion dysregulation, responses to which may be influenced by an individual's willingness and/or ability to accurately report on emotional responses (Tull, Bornovalova, Patterson, Hopko, & Lejuez,2008). Consequently, there is a need for studies in this area that utilize more objective measures of emotion dysregulation, such as laboratory-based behavioral measures. In addition to capturing in-the-moment deficits in emotion regulation, behavioral measures of emotion dysregulation are not susceptible to the same biases as self-report measures. Further, the joint use of behavioral and self-report measures of emotion dysregulation in the same study may assist in providing a more accurate and comprehensive assessment of this complex and multifaceted construct (McHugh et al., 2011).

Thus, the goal of the present study was to examine the experience of PTS symptoms as a prospective predictor of the severity of substance use 8 months later among a sample of young adult women who had been exposed to a potentially traumatic event. Moreover, we were interested in investigating whether emotion dysregulation (assessed across both subjective and behavioral domains) moderates this association. We hypothesized that the initial experience of more severe PTS symptoms would predict more severe (i.e., frequent) substance use 8 months later, even when taking into account baseline levels of substance use severity. However, we also expected that this relationship would be moderated by

emotion dysregulation, such that PTS symptom severity would predict more severe substance use 8 months later only among individuals with heightened self-reported and behaviorally indexed emotion dysregulation.

2. Method

2.1. Participants

Participants were drawn from a large prospective study of emotion dysregulation and sexual revictimization among young adult women in the community (the population most at risk for sexual victimization; see Breslau et al., 1998; Pimlott-Kubiak & Cortina, 2003). Recruitment methods included random sampling from the community, in addition to community advertisements. With regard to random sampling, women within the targeted age range (18–25) were identified from a large database of residential mailing addresses compiled by Survey Sampling International (SSI), a private research organization that provides sampling services to government and academic research entities. Information used to identify household members matching the designated gender and age criteria was obtained by SSI from a variety of secondary sources including school and voter registration lists. Randomly selected individuals from this list were sent a letter inviting them to participate in a longitudinal study of prior life events and current adjustment. The recruitment letter contained a description of the project, a post-paid response card to be mailed back by interested individuals, and a $1 cash incentive. The letter also informed recipients that project personnel would attempt to contact them by telephone to answer any questions they may have about the study.

These procedures resulted in the recruitment of 151 women from a metropolitan area in the Southern United States. Of these151 women, 133 (88.1%) reported directly experiencing (i.e., "happened to me") at least one potentially traumatic event (see Section 2.2) and, thus, were eligible for inclusion in the present study. Of the 133 eligible participants, four were excluded for not completing one or more of the measures of interest at the baseline assessment, and 23 were excluded for not completing the follow-up assessment.[1] Thus, the final

sample consisted of 106 women who reported exposure to at least one potentially traumatic event.

The final sample of participants (N = 106) ranged in age from 18 to 25 years (M = 21.9, SD = 2.0) at the time of the initial assessment and were ethnically diverse (76.7% African American; 21.4%White; 2.8% Multiracial; 1.9% Latina). With regard to educational attainment, 97.2% of participants had received their high school diploma or GED, with many (82.1%) continuing on to complete at least some higher education. The majority of participants (67.0%)were full-time students, with an additional 7.5% enrolled part-time. Most participants (89.6%) were single.

2.2. Measures

2.2.1. Potentially traumatic event exposure and posttraumatic stress symptoms

Participants completed the *Life Events Checklist* (LEC: Blake et al., 1990; Gray, Litz, Hsu, & Lombardo, 2004) to assess lifetime exposure to potentially traumatic events. This checklist was developed in conjunction with the Clinician Administered PTSD Scale (Blake et al., 1990) and provides a list of 17 potentially traumatic events (e.g., sexual assault, physical assault, motor vehicle accident, unexpected death of a loved one, life-threatening illness). Participants were asked to indicate all of the events that they had directly experienced as well as which of these endorsed events was the most traumatic for them. Participants were instructed to reference their most traumatic event when completing the PTSD Checklist. Participants who did not endorse direct experience with an event did not complete the PTSD Checklist and were not included in this study.

The *PTSD Checklist–Civilian Version* (PCL; Weathers, Litz, Herman, Huska, & Keane, 1993) is a widely used 17-item self-report measure of the severity of reexperiencing, avoidance, emotional numbing, and hyperarousal symptoms experienced in response to a potentially traumatic event. Participants completed the PCL in reference to the event previously identified as most traumatic on the LEC. The items on the PCL correspond to the *Diagnostic and Statistical Manual of Mental Disorders*, 4th edition, text revision (DSM-IV-TR; American Psychiatric Association, 2000) criteria for a PTSD diagnosis. Using a 5-point Likert-type scale (1 = not at all, 5 = extremely),participants rate the extent to which each

symptom has bothered them in the past month. The validity of the PCL has been demonstrated in civilian populations (Blanchard, Jones-Alexander, Buckley, & Forneris, 1996). The PCL has also been found to have strong test-retest reliability (r = .96) as well as moderate to strong correlations with other PTSD measures (Weathers et al., 1993). Further, the subscales of the PCL demonstrate high levels of agreement with the *Clinician Administered PTSD Scale* (Blake et al., 1990), a well-established and empirically supported interview-based measure of PTSD (Grubaugh, Elhai, Cusack, Wells, & Frueh, 2007; Palmieri, Weathers, Difede, & King, 2007). Given evidence that PTSD is best represented as a dimensional construct (Broman-Fulks et al., 2006; Forbes, Haslam, Williams, & Creamer, 2005; Ruscio, Ruscio, & Keane, 2002), participants' responses to each item were summed to provide a total score representing overall PTS symptom severity. Internal consistency of the total score within this sample was excellent (α = .95).

2.2.2. Emotion dysregulation

The *Difficulties in Emotion Regulation Scale* (DERS; Gratz &Roemer, 2004) is a 36-item self-report measure that assesses individuals' typical levels of emotion dysregulation across six domains: nonacceptance of negative emotions, inability to engage in goal-directed behaviors when distressed, difficulties controlling impulsive behaviors when distressed, limited access to emotion regulation strategies perceived as effective, lack of emotional awareness, and lack of emotional clarity. The DERS has been found to demonstrate good test-retest reliability (ρ_I = .88, p < .01) and adequate construct and predictive validity (Gratz & Roemer, 2004; Gratz & Tull, 2010). Further, the DERS has been found to predict performance on behavioral measures of emotion regulation and the willingness to experience emotional distress (for a review, see Gratz & Tull, 2010). The overall score was used in this study. Items were recoded so that higher scores indicate greater emotion dysregulation, and a sum was calculated. Internal consistency in the current sample was good (α = .95).

To obtain a behavioral index of emotion dysregulation, participants completed a modified version of the *Paced Auditory Serial Addition Task–Computerized* (PASAT-C; Gratz, Rosenthal, Tull, Lejuez, & Gunderson, 2006; Lejuez, Kahler, & Brown, 2003). During this

task, numbers are sequentially flashed on a computer screen, and participants are instructed to sum the most recent number with the previous number (using the computer mouse to click on the correct answer). After providing each sum, the participant must ignore the sum and add the following number to the most recently presented number. When a correct answer is provided, a point is obtained. If an incorrect answer is provided, or if the participant fails to provide an answer before the next number is presented, an "explosion" sound is played and the score does not change. This version of the PASAT-C consisted of four levels, the first three of which had increasingly shorter latencies between number presentations (see Lejuez et al. (2003) for additional detail on the specific length of time between number presentations across the different levels of the PASAT-C). Following the third level and a brief 1 min rest period to complete the negative emotion ratings (see below),the final level began. The final level had the same latency between number presentations as the third level but lasted seven minutes and included an option to terminate the task. Specifically, participants were informed that they could terminate the task at any time once the final level began; however, their performance on this task (including the length of time they persisted on it) would determine the amount of reimbursement they received at the end of the study (although in actuality all participants were reimbursed the same amount at the end of the study). Latency in seconds to task termination is used as a measure of the emotion dysregulation dimension of the willingness to experience emotional distress in order to pursue goal-directed behavior.

In support of its construct validity, this task has been shown to induce emotional distress in the form of anxiety, anger, frustration, and irritability among clinical and nonclinical samples (Bornovalova et al., 2008; Gratz, Rosenthal, Tull, Lejuez, &Gunderson, 2010; Lejuez et al., 2003). Further, latency to termination scores on this task have been found to be significantly correlated with other behavioral measures of the willingness to experience distress (Bornovalova et al., 2008; Gratz, Bornovalova, Delany-Brumsey, Nick, & Lejuez, 2007; McHugh et al., 2011), as well as self-report measures of emotion dysregulation, emotional avoidance, and emotional nonacceptance (Gratz et al., 2006, 2007; Tull, Gratz, Latzman, Kimbrel, & Lejuez, 2010). Further, providing evidence that latency to termination

scores on this task are not simply a measure of skill level or distress in response to the task, neither negative affect (NA) in response to the task nor task performance has been found to be significantly associated with latency to task termination (Bornovalova et al., 2008; Gratz et al., 2007).

To determine whether this behavioral index of emotion dysregulation was best represented as a continuous or dichotomous variable, we examined whether latency in seconds to task termination was normally distributed. According to the Shapiro-Wilk test (Shapiro & Wilk, 1965), latency to terminate the PASAT-C was not normally distributed (Shapiro-Wilk = .46, $p < .001$), supporting dichotomization of this variable (see MacCallum, Zhang, Preacher, & Rucker, 2002). Providing further support for the use of a dichotomous PASAT-C variable, the majority (55%) of participants who terminated (19%) the task did so within the first 2 min of the final level, and the mean latency to terminate the task among participants who quit the PASAT-C was 154.15 s ($SD = 147.65$). Consequently, and consistent with previous studies (e.g., Gorka, Ali, & Daughters, 2012; Gratz et al., 2006; Schloss & Haaga, 2011; Tull & Gratz, 2013), unwillingness to experience emotional distress was indexed by PASAT-C quit status, with individuals who quit the task categorized as having greater unwillingness to experience emotional distress (i.e., greater emotion dysregulation).

As a manipulation check to ensure that the task induced emotional distress in this sample, participants completed the negative affect (NA) subscale of the *Positive and Negative Affect Schedule* (PANAS-NA; Watson, Clark, & Tellegen, 1988) before the PASAT-C and immediately prior to receiving the option to terminate the PASAT-C (see Section 3.3), rating the extent to which they were currently experiencing 10 forms of NA (e.g., afraid, ashamed, distressed, hostile) on a scale from 1 (*very slightly or not at all*) to 5 (*extremely*). The PANAS-NA has excellent psychometric properties (see Roemer, 2001; Watson et al., 1988), evidencing positive associations with measures of general psychiatric distress, depression, anxiety, and stress (Brown, Chorpita, Korotitsch, & Barlow, 1997; Roemer, 2001; Watson et al., 1988). Internal consistencies for the PANAS-NA at both time points were adequate (αs = .71 and .82 at pre- and post-task, respectively).

2.2.3. Substance use severity

To assess substance use severity, participants completed the *Drug Use Questionnaire* (DUQ; Hien & First, 1991), a self-report measure used to assess frequency of alcohol and drug use over the past year (at baseline) and in the past four months (at follow-up). The DUQ characterizes frequency of use in a manner consistent with the substance use disorder module of the *Structured Clinical Interview for DSM-IV* (SCID-IV; First & Gibbon, 2004). Specifically, participant rate the frequency with which they have used each substance on a 6-point Likert-type scale (0 = *never*; 1 = *one time*; 2 = *monthly or less*; 3 = *2–4 times per month*; 4 = *2–3 times per week*; 5 = *4 or more times per week*). Responses are summed to create an overall score representing frequency of substance use for a variety of substances (i.e., alcohol, cannabis, cocaine, hallucinogens, PCP, MDMA, inhalants, stimulants, sedatives, and opiates). In support of the measure's construct validity, scores on this measure have been found to be associated with a number of constructs theoretically and empirically linked to substance use disorders, including cravings (Tull, Kielet al., 2013), impulsivity (Lejuez, Bornovalova, Reynolds, Daughters,& Curtin, 2007), emotion dysregulation (Bornovalova, Ouimette, Crawford, & Levy, 2009; Gratz, Tull, Baruch, Bornovalova, & Lejuez,2008), emotional reactivity (Dixon-Gordon, Tull, & Gratz, 2013), and borderline personality and related behaviors (Bornovalova, Tull, Gratz, Levy, & Lejuez, 2011; Gratz et al., 2008). Further, scores on this measure demonstrate convergence with SCID-IV substance use disorder diagnoses in associations with relevant outcomes (Lejuez et al., 2007). The current study used DUQ data from both the baseline and follow-up assessments. Given the checklist nature of the DUQ, internal consistency statistics were not calculated.

2.3. Procedure

The current study uses data from two time points: the baseline assessment (T1) and the follow-up lab assessment 8 months later (T2). All procedures received approval by the Institutional Review Board of the participating institution. At the baseline assessment, after providing written informed consent, participants completed a diagnostic interview and a series of self-report questionnaires. All questionnaires were administered online and com-

pleted on a computer in the laboratory. Next, participants completed the laboratory portion of the study, including the PASAT-C. Specifically, following a 5-min baseline period, participants received standardized instructions for completing the PASAT-C. Once participants confirmed that they understood the instructions, the PASAT-C began. Upon completion of the baseline assessment, participants were reimbursed $75. At the follow-up assessment 8 months later, participants returned to the laboratory to complete the same self-report questionnaires and laboratory tasks as in the baseline assessment. Participants unable to return to the laboratory were given the option to complete the self-report questionnaires online from home.[2] Upon completion of the 8-month follow-up assessment, participants were reimbursed $50.

2.4. Data analytic strategy

Bivariate correlations and descriptive statistics for the variables of interest are reported in table 1. Aiken and West's (1991) recommendations for testing interaction effects were used to examine both T1 self-report (i.e., DERS) and behavioral (PASAT-C) indices of emotion dysregulation as moderators of the relation between T1PTS symptoms (PCL) and T2 substance use severity (DUQ), while controlling for T1-DUQ. Predictor variables and one covariate (T1-DUQ) were entered into the first step of each model. The interaction terms (i.e., T1-PCL × T1-DERS and T1-PCL × T1-PASAT-C, respectively) were entered into the second step of each model. T2-DUQ served as the dependent variable in both models. Predictor variables were centered at their means prior to creating interaction terms. Simple slopes analysis was conducted to further investigate significant interactions (Aiken & West, 1991). More specifically, two simple regression equations were constructed in which the relationship between the independent and dependent variables was tested at both high (+1 *SD*) and low (–1 *SD*) levels of the moderator variable.

Table 1. Mean, standard deviations, and bivariate correlations for study variables

Variables	1	2	3	4	5
T1 PCL	—				
T1 DERS	.43**	—			
T1 PASAT-C	–.04	.03	—		
T1 DUQ	.18	.21*	–.01	—	
T2 DUQ	.20*	.18	.14	.77**	—
Mean	28.62	69.45	.19	3.81	1.04
SD	13.76	21.77	.39	3.51	1.78
Minimum	17	40	0	0	0
Maximum	85	132	1	16	9

Note: $N = 106$. T1 = baseline assessment; T2 = 8-month follow-up assessment; PCL = Posttraumatic Stress Disorder Checklist total score; DERS = Difficulties in Emotion Regulation Scale total score; PASAT-C = Paced Auditory Serial Addition Task – Computerized Version (0 = completed task, 1 = terminated task); DUQ = Drug Use Questionnaire total. The T1 DUQ assesses past-year substance use, whereas the T2 DUQ assesses substance use within the past 4 months; consequently, it would be expected that mean substance use frequency for the T1 DUQ would be higher relative to that obtained from the T2 DUQ.

*$p < .05$, **$p < .001$

3. Results

3.1. Potentially traumatic event exposure

In regard to the potentially traumatic events that were identified as most traumatic (and thus served as the basis for the PCL) by the final sample ($N = 106$), 20 participants (18.9%) identified an unwanted sexual experience, 23 participants (21.7%) identified exposure to a sudden unexpected or violent death, 19 participants (17.9%) identified experiencing a transportation accident, 12 participants (11.3%) identified exposure to a natural disaster, 10 participants (9.4%) identified experiencing a physical assault (with or without a weapon), 8 participants (7.5%) identified experiencing a rape, 2 participants (1.9%) identified exposure to fire or explosion, 2 participants (1.9%) identified experiencing a serious accident, 1 participant (0.9%) identified experiencing captivity, 1 participant (0.9%) identified exposure to serious injury, harm or death, and 8 participants (7.5%) identified experiencing a potentially traumatic event not listed on the LEC.

3.2. T2 substance use

Our primary analyses focus on the frequency with which participants used any substances during the follow-up period. However, to better place our findings within the context of

the current literature, we ran frequency analyses to evaluate the substances most commonly used (≥ 1 time) by participants during the follow-up period. The most commonly used substance was alcohol, used by 34.9% of participants during the follow-up period (n = 37). Other substances used during this time included cannabis (13.1%, n = 14), stimulants (1.8%, n = 2), and sedatives (0.9%, n = 1). Of note, no participants reported using substances during the follow-up period at a rate that would indicate the presence of a substance use disorder (i.e., 4 or more times per week).

3.3. Manipulation check

Providing support for the use of the PASAT-C as a measure of the unwillingness to experience emotional distress, results of a 2 (quit vs. no quit) × 2 (pre- vs. post-task) repeated measures analysis of variance (ANOVA) for NA revealed a significant main effect of time, $F(1, 104) = 74.43$, $p < 0.001$, $\eta_p^2 = 0.42$, demonstrating that the PASAT-C resulted in a significant increase in NA across all participants. Further, the quit × time interaction was not significant, $F(1, 104) = .20$, $p = 0.65$, $\eta_p^2 = 0.002$, indicating that the decision to quit the task was not simply due to the greater experience of NA.

3.4. Primary analyses

All variables of interest, including our outcome variable (T2-DUQ), fell within the acceptable range of normality (Kline, 2011).Thus, all analyses utilized nontransformed data. In the first step of the first model, T1-DUQ significantly predicted T2-DUQ (see table 2). T1-PCL and T1-DERS did not significantly predict T2-DUQ.As predicted, the interaction of T1-PCL and T1-DERS significantly predicted T2-DUQ in the second step of the model. Simple slopes analysis revealed a significant positive association between T1-PCL and T2-DUQ for participants with high T1-DERS (B = .022, β = .17, p = .03), but not low T1-DERS (B = −.02, β = .07, p = .35; see fig. 1).

Table 2. Hierarchical multiple regression analyses predicting time 2 substance use

Predictor	*B*	*β*	ΔR^2
Model 1			
Step 1			.60***
T1 DUQ	.39	.76***	
T1 PCL	.01	.07	
T1 DERS	−.01	−.01	
Step 2			.03**
T1 DUQ	.39	.77***	
T1 PCL	.01	.02	
T1 DERS	−.01	−.05	
T1 PCL × T1 DERS	.01	.18**	
Model 2			
Step 1			.62***
T1 DUQ	.39	.76***	
T1 PCL	.01	.07	
T1 PASAT-C	.67	.15*	
Step 2			.05***
T1 DUQ	.37	.73***	
T1 PCL	.01	.06	
T1 PASAT-C	.74	.16**	
T1 PCL × T1 PASAT-C	.07	.23***	

Note: N = 106. T1 = baseline assessment; PCL = Posttraumatic Stress Disorder Checklist total score; DERS = Difficulties in Emotion Regulation Scale total score; PASAT-C = Paced Auditory Serial Addition Task – Computerized Version; DUQ = Drug Use Questionnaire total.

*p < .05, **p < .01, ***p < .001

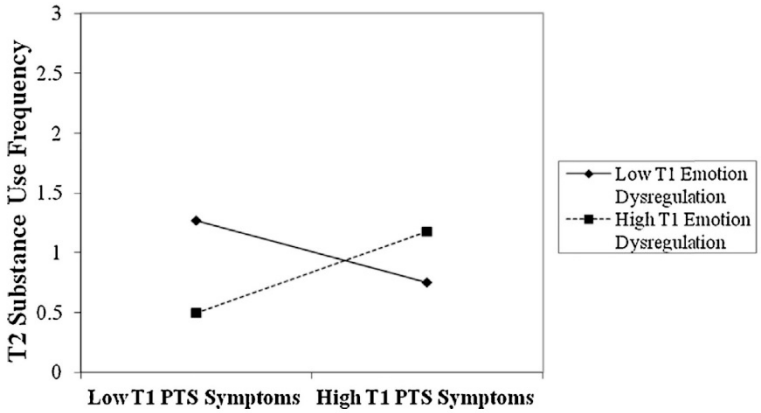

Figure 1. Interaction of PTS symptoms and self-reported emotion dysregulation predicting substance use 8 months later. The interaction of T1 PTS symptoms and T1 DERS was a significant predictor of T2 substance use (B = .01, β = .18, p < .01, ΔR^2 = .03).

In the first step of the second model, both T1-DUQ and T1-PASAT-C significantly predicted T2-DUQ (see table 2). T1-PCL did not significantly predict T2-DUQ. As predicted, however, the interaction of T1-PCL and T1-PASAT-C significantly predicted T2-DUQ in the second step of the model. Simple slopes analysis revealed a significant positive association between T1-PCL and T2-DUQ only among participants who quit the PASAT-C (B = .04, β = .28, p < .001);no significant association was found for participants who did not terminate the PASAT-C (B = −.02, β = −.16, p = .06; see fig. 2).

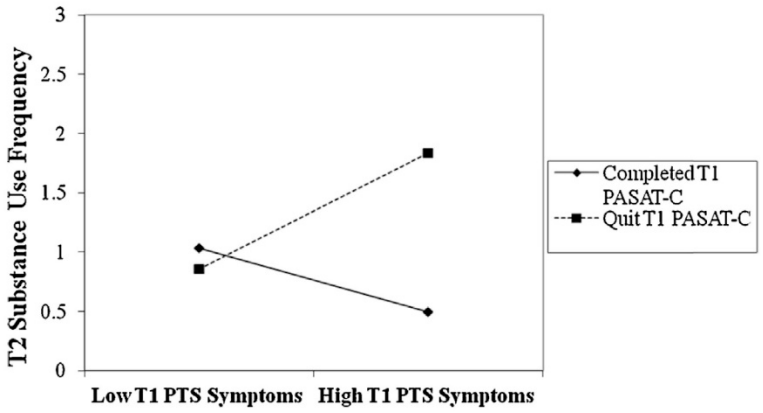

Figure 2. Interaction of PTS symptoms and behaviorally indexed emotion dysregulation predicting substance use 8 months later. The interaction of T1 PTS symptoms and T1 PASAT-C was a significant predictor of T2 substance use frequency (B = .07, β = .23, p < .001, ΔR^2 = .05).

4. Discussion

The goal of the present study was to build upon past research demonstrating an association between the experience of PTS symptoms and substance use by examining the role of emotion dysregulation in moderating this relation. Contrary to past research indicating a significant association between PTS symptoms and substance use in community, veteran, and clinical populations (e.g., Chilcoat & Breslau, 1998; Haller & Chassin, 2013; Jakupcak et al., 2010; Kaysen et al., 2014; Leeies et al., 2010; Simpson et al., 2014), findings from this study did not reveal a main effect of PTS symptoms on later substance use. Within this

community sample of young adult women, the absence of a significant association between PTS symptoms and later substance use suggests that the self-medication model (Khantzian, 1997; Stewart, 1996) may not be adequate to explain the connection between PTS symptoms and substance use demonstrated in previous studies. Instead, findings suggest the importance of considering emotion dysregulation in this relationship, as PTS symptoms were only associated with later substance use in the context of heightened emotion dysregulation(assessed using both self-report and behavioral measures).

Consequently, it may not be the severity of PTS symptoms per se that motivates substance use, but the extent to which those symptoms are experienced in conjunction with heightened emotion dysregulation. The combined influence of PTS symptom severity and emotion dysregulation may be particularly likely to tax self-regulatory resources (consistent with an ego-depletion model of self-regulation; Baumeister, 2002), which, in turn, may limit the ability to control impulsive behaviors or increase reliance on behaviors that facilitate quick escape from negative affective states. Findings from the present study are in line with those of Simpson et al. (2014), who demonstrated that negative affect reduction and positive affect enhancement motives moderated the relationship between PTS symptoms and alcohol use in a sample of men and women with PTSD and alcohol dependence (although a direct relation between PTS symptoms and alcohol use was also found) and further highlight the need to consider the role of emotion regulation in the relationship between PTS symptoms and problematic behaviors. It is also worth noting that the observed interaction remained significant when taking into account past year substance use, which, as expected, demonstrated a strong relation to substance use during the follow-up period. Thus, results suggest the robust nature of this interaction in predicting future substance use severity.

This study is the first to utilize both self-report and behavioral measures of emotion dysregulation in examining the moderating role of emotion dysregulation in the association between PTS symptoms and later substance use. Notably, the same pattern of findings was obtained for both the subjective and behavioral indices of emotion dysregulation, underscoring the robust influence of emotion dysregulation across multiple domains in risk

for substance use among individuals with PTS symptoms. Moreover, the unwillingness to experience distress on the behavioral measure was, in and of itself, predictive of substance use 8 months later. This finding adds to a growing body of literature demonstrating that the unwillingness to experience distress as assessed by the PASAT-C is associated with a variety of negative clinical outcomes and maladaptive behaviors, including problematic alcohol use (Gorka et al., 2012), residential substance use treatment dropout (Daughters, Lejuez, Bornovalova et al., 2005; Tull, Gratz, Coffey, Weiss, & McDermott, 2013), length of abstinence attempts (Daughters, Lejuez, Kahler, Strong, & Brown, 2005), risky sexual behavior (Tull & Gratz, 2013), and suicide (Anestis, Gratz, Bagge, & Tull, 2012; Anestis, Tull, Bagge, & Gratz, 2012). Consequently, this measure may have utility as a convenient method for quickly identifying individuals at heightened risk for the development of maladaptive behaviors.

Although the results of this study extend current research on the relation between PTS symptoms and substance use, several limitations warrant mention. First, participants may have difficulty accurately reporting on their past substance use. Consequently, future studies may benefit from the use of interview-based procedures (e.g., timeline follow-back; Carey, 1997) designed to obtain valid estimates of past substance use, as well as daily monitoring methods or interactive voice response technology. In assessing substance use, we also collapsed use across a variety of different substances. Consequently, findings from this study cannot speak to the relative relevance of our model (and emotion dysregulation) to alcohol versus other drug use. Future studies would benefit from examining unique associations between emotion dysregulation and different substances among individuals with PTS symptoms, given evidence that PTS symptoms may be differentially related to alcohol and drug use. For example, within a community sample, Haller and Chassin (2013) found that the experience of PTS symptoms was directly related to the later development of drug problems but not alcohol problems. Further research in this area would help clarify the extent to which alcohol and drug use serve similar or different functions among individuals experiencing PTS symptoms. Although the use of a diverse sample of young adult women from the community is a strength of this study, it is not clear whether the present

results would generalize to clinical populations of individuals with PTSD and/or substance use disorders, or to men. Indeed, although inclusion in this study required that all participants report directly experiencing at least one potentially traumatic event, the fact that participants were recruited from the community (vs. a clinical setting) likely resulted in a sample with less severe PTS symptoms and substance use than would be found among individuals in a clinical setting. In addition to accounting for the lower severity of substance use during the follow-up period, the use of a community sample could also account for our failure to find a significant relation between PTS symptom severity and substance use frequency. Consequently, replication of these findings in larger, mixed-gender clinical and community populations is needed.

Future studies should explore potential mechanisms that may underlie the relations among PTS symptoms, emotion dysregulation, and substance use. In particular, given experimental evidence that the severity of NA in response to trauma-related cues predicts both craving intensity and attentional bias to substance-related cues among individuals with PTSD (Tull et al., 2011; Tull, Kiel et al.,2013), both cravings and attentional bias to substance-related cues warrant attention as potential mechanisms underlying the relation between PTS symptoms, emotion dysregulation, and substance use. In addition, studies have shown that both PTSD and emotion dysregulation are associated with greater risk-taking and impulsivity, as well as worse risk perception (Joseph, Dalgleish, Thrasher, & Yule, 1997; Messman-Moore, Walsh, & DiLillo, 2010; Tull et al., 2009;Tull, Weiss, Adams, & Gratz, 2012; Walsh, DiLillo, & Messman-Moore, 2012; Weiss et al., 2012), which may increase risk for more severe substance use.

Finally, it warrants mention that our behavioral measure of emotion dysregulation was not significantly associated with our self-report measure of emotion dysregulation, or with PTS symptom severity. These findings are consistent with past research examining these constructs, which has also failed to find significant zero-order associations between the PASAT-C and both self-report measures of overall emotion dysregulation (Ameral, Palm Reed, Cameron, & Armstrong, in press; McHugh et al., 2011; Tull et al., 2010) and PTS (Marshall-Berenz, Vujanovic, Bonn-Miller, Bernstein, & Zvolensky, 2010; Tull, Gratz et al.,

2013). The lack of a significant relation of the PASAT-C to self-report measures of overall emotion dysregulation may be due to the fact that the PASAT-C assesses only one particular dimension of emotion dysregulation (i.e., the unwillingness to experience emotional distress) and, thus, may not evidence strong associations with the broader construct of emotion dysregulation in general. In support of this premise, studies have found that the PASAT-C is significantly associated with self-reported emotional avoidance and emotional nonacceptance (Gratz et al., 2007; Tull et al., 2010). The lack of relations between self-report and behavioral measures of emotion dysregulation could also reflect measurement issues and the potential for retrospective recall and social desirability biases with self-report measures. Alternatively, these findings may simply reflect the fact that these measures are tapping into different aspects of an overarching construct of emotion dysregulation. Specifically, by their very nature, self-report measures of emotion dysregulation assess perceived emotion dysregulation and typically reflect general levels of emotion dysregulation over time and across context. The PASAT-C, on the other hand, was designed to assess in-the-moment unwillingness to experience emotional distress specific to particular emotional states (i.e., frustration or generalized distress). Thus, one explanation for the absence of a significant relation between the PASAT-C and PTS symptom severity may be that PTS symptom severity is associated with the unwillingness to experience distress only under certain contexts (e.g., following exposure to traumatic event reminders) or in response to specific emotions (e.g., fear).Future research is needed to evaluate why self-report and behavioral measures of emotion dysregulation are often not associated with one another and how both measures may contribute to our understanding of an overarching emotion dysregulation construct. Research is also needed to examine the contexts under which individuals experiencing PTS symptoms may be more likely to exhibit emotional unwillingness on behavioral measures of emotion dysregulation.

Despite limitations, results provide support for emotion dysregulation as a key factor that may increase risk for substance use among women experiencing PTS symptoms. In demonstrating the relevance of emotion dysregulation to later substance use among young adult women experiencing PTS symptoms, these findings highlight the need to evaluate

the extent to which interventions that explicitly target emotion dysregulation may reduce risk for substance use among those with PTS symptoms. For example, Gratz, Tull, and Levy (2014) have found that a brief, adjunctive emotion regulation group therapy can significantly reduce various forms of self-destructive impulsive behaviors (e.g., nonsuicidal self-injury, disordered eating behaviors, substance use) by focusing specifically on improving emotion regulation. Stasiewicz and colleagues (2013) also found that affect regulation training combined with cognitive behavioral therapy was efficacious in reducing alcohol use behaviors among negative affect drinkers. Incorporating such interventions into standard treatments for PTS (e.g., prolonged exposure, cognitive processing therapy; Foa, Hembree, & Rothbaum, 2007; Resick, Monson, & Chard, 2007) may assist in preventing the development of substance use behaviors within this at-risk population. Alternatively, further research is needed to determine the extent to which gold-standard treatments for PTSD, such as prolonged exposure and cognitive processing therapy, reduce emotion dysregulation in and of themselves. By reducing the severity of PTS symptoms, these treatments may indirectly alleviate emotion dysregulation, resulting in lowered risk for later substance use.

Notes

1. Participants who completed (vs. those did not) the T2 assessment reported significantly lower self-reported emotion dysregulation at T1 (t[127] = 2.13, p = .04; M = 69.45 [SD = 21.77], and M = 80.65 [SD = 27.55], respectively). No other significant between-group differences (ps > .05) were found on demographics or any other measure under investigation.
2. Only 17 participants (16%) were not able to return to the lab for the follow-up assessment and thus completed their questionnaires online from their home. There were no significant differences on the T2-DUQ between those participants who completed their follow-up assessment in the lab or at home, t(104) = –.10, p = .93.

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