

Pre- to Posttreatment Changes in Trauma-Cued Negative Emotion Mediate Improvement in PTSD, Depression, and Impulsivity

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ABSTRACT

Objective: PTSD is characterized by strong negative emotions, often in response to trauma cues or reminders. Subsequent emotion regulation strategies impact the maintenance of PTSD symptoms and other trauma-related outcomes (depression, substance use). This study aimed to examine a range of trauma-cued emotions to enhance our understanding of changes following treatment and their potential role in improving relevant outcomes. **Method:** Participants included 67 veterans diagnosed with PTSD and a substance use disorder who completed a dual diagnosis residential program that used Cognitive Processing Therapy. At pre- and posttreatment, we measured eight negative emotions following a trauma recall and PTSD symptoms, depressive symptoms, and negative urgency (impulsivity following negative emotions) as treatment outcomes. We used t-tests to assess changes at posttreatment and a within-subjects mediational analysis to test whether changes in trauma-cued emotions mediated treatment outcomes. **Results:** Participants reported moderate, significant decreases for five emotions at posttreatment: anger-at-self, disgust-at-self, fear, guilt, and sadness ($d \geq 0.50$); whereas, nonsignificant changes were found for anger-at-others, disgust-at-others, and shame. Mediation analyses indicated greater reductions in trauma-cued sadness had a significant indirect effect on improvement in PTSD symptoms, depressive symptoms, and negative urgency. Reductions in disgust-at-self and fear also demonstrated a significant indirect effect on depressive symptom improvement. **Conclusions:** In this dual diagnosis program, veterans reported a significant reduction in some, but not all trauma-cued emotions and improvements in only select emotions accounted for a significant portion of improvement in relevant treatment outcomes.

KEYWORDS

posttraumatic stress disorder, trauma-cued emotions, substance use disorders, depression, mediation

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Posttraumatic stress disorder (PTSD) is characterized by strong, pervasive, negative emotions such as fear, anger, and sadness, as well as self-conscious emotions such as disgust, guilt, and shame ([Criteria D-E] American Psychiatric Association, 2013; McLean & Foa, 2017). These emotions often arise in response to internal or external reminders of the trauma; conventional language describes this phenomenon as *being triggered* by traumatic cues. A hallmark of PTSD functional impairment is the use of maladaptive strategies, including avoidance and substance use, which not only function to manage negative trauma-related emotions, but also contribute to the maintenance of PTSD symptoms (Bardeen, Kumpula, & Orcutt, 2013; Seligowski, Lee, Bardeen, & Orcutt, 2015). In turn, a goal of trauma-focused therapies is to promote emotion regulation and adaptive coping strategies. Thus, understanding trauma-cued emotional states is important for purposes of treatment planning and intervention. The current study examined how changes in negative trauma-cued emotions are associated with improvements in treatment outcomes (i.e., PTSD, depression, impulsivity) in patients seeking treatment at a dual diagnosis clinic (PTSD and substance use disorder [SUD]) in a U.S. Veterans Affairs (VA) Medical Center.

PTSD, depression, and SUD are highly comorbid in veterans seeking mental health treatment. Negative emotions and subsequent maladaptive emotional regulation strategies likely account for at least some of the high comorbidity of PTSD with other trauma-related outcomes such as depression and substance abuse. Depression is highly comorbid with PTSD in veterans (Stander, Thomsen, & Highfill-McRoy, 2014) and this comorbidity is associated with more chronic and severe PTSD symptoms over time (e.g., Sripada et al., 2017) and greater risk for suicide attempts (Kimbrel, Meyer, DeBeer, Gulliver, & Morissette, 2016). Depression is often characterized by negative rumination, a maladaptive emotion regulation strategy that is associated with the maintenance of both PTSD and depressive symptoms (Bennett & Wells, 2010). Therefore, targeting emotional distress following trauma cues may have a positive impact on depressive symptoms. Given the potential for trauma cues to trigger negative emotions directed at the self (e.g., disgust at self, anger at self) and depressive tendencies to endorse negative self-attributions, specific reductions in self-directed, trauma-cued emotions may play an important role in the improvement of depressive symptoms.

PTSD and SUD (e.g., alcohol use disorder, cocaine use disorder, etc.) also co-occur frequently with high comorbidity rates in veteran samples (Petrakis, Rosenheck, & Desai, 2011). Past research on this comorbidity supports the negative reinforcement (Baker, Piper, McCarthy, Majeskie, & Fiore, 2004) and self-medication models (Brady, Back, & Coffey, 2004), which posit that substances are used to relieve or lessen the intensity of PTSD symptoms, including negative emotions. This strategy increases the likelihood of future use and perpetuates existing

PTSD symptoms (e.g., Coffey et al., 2010). Additionally, both SUD and PTSD are characterized by an urgency to act impulsively to escape or avoid affective distress (Cyders & Smith, 2007; Whiteside & Lynam, 2001), which has been associated with higher levels of substance use and risky behaviors with significant health consequences (e.g., Weiss, Tull, Sullivan, Dixon-Gordon, & Gratz, 2015). In a clinical sample similar to the current study's, SUD patients with PTSD reported significantly higher negative urgency (i.e., tendency to act impulsively in response to negative emotions) than SUD patients without PTSD (Weiss, Tull, Anestis, & Gratz, 2013). In a separate study, Schoenleber and colleagues (2018) examined trauma-exposed patients in a residential SUD treatment program and found patients with a PTSD diagnosis reported significantly higher anger, anxiety, and negative self-conscious emotions (i.e., shame, guilt) following a trauma cue compared to those without a PTSD diagnosis. Thus, for people with this comorbidity, a trauma reminder that elicits strong negative emotions could be a particularly salient risk factor for impulsivity and substance use.

Given the prevalence of strong negative emotions following trauma exposure and the subsequent maladaptive emotion regulation strategies often used, particularly in dual diagnosis populations, front-line trauma-focused treatments aim to reduce the intensity of negative emotions (cf., Criterion D, APA, 2013). For instance, the treatment models employed in VA PTSD/SUD clinics (e.g., Cognitive Processing Therapy [CPT], Prolonged Exposure) assume that attenuating negative trauma-cued emotions will contribute to downstream better coping and fewer symptoms; however, few studies have empirically tested this in an ecologically valid clinical setting. In this study, we used data collected from a larger program evaluation study of a residential treatment program for veterans with co-occurring PTSD and SUD to examine the association of reductions in the intensity of negative trauma-cued emotions to pre- to posttreatment improvements in PTSD symptoms, depressive symptoms, and negative urgency. This six-week, residential day-treatment program includes treatment components aimed to target both PTSD and SUD. The core treatment modality of this program is CPT, an evidence-based trauma-focused cognitive behavioral therapy that uses cognitive restructuring to identify and alter maladaptive beliefs about the trauma, as well as other generalized cognitive distortions (Resick, Monson, & Chard, 2014). Key CPT exercises (e.g., Challenging Belief Worksheets) require patients to describe the type and severity of negative emotions associated with a trauma-related cognitive distortion. Following cognitive restructuring, patients rate the severity of associated emotions again to assess whether using this technique has successfully reduced affective distress.

Previously reported findings from this program evaluation study suggested CPT is an appropriate treatment for patients with co-occurring PTSD and SUD, with significant reductions in PTSD and depressive symptoms in this population (Peck, Coffey, McGuire, Voluse, & Connolly, 2018). That study also found changes in trauma-related cognitions were associated with improvements in treatment outcomes, as expected when using CPT. However, it is largely unknown whether emotional responses to trauma cues change after CPT-based treatment, and, if so, whether the magnitude of changes differ across the wide range of potential negative emotions experienced. Select studies have assessed specific emotional states in response to trauma cues, some of which included populations with comorbid SUD (Schoenleber et al., 2018), but those findings are limited by cross-sectional analysis. One study tested the habituation of anxiety and disgust following a repeated exposure to a trauma cue in a single session design and found a decrease in both emotions across exposure trials (Badour & Feldner, 2016). Although important, these results are similarly limited by measuring changes in a one-time experimental session (i.e.,

not treatment) and that sample was restricted to women with a history of sexual victimization. Therefore, extant research does not necessarily inform how trauma-cued emotions might change after treatment. Further, it is unclear how changes in trauma-related emotional states are associated with changes in relevant treatment outcomes for a complex, dual diagnosis population. Identifying how improvements in specific trauma-cued emotions relate to treatment outcomes could expand our understanding of treatment effects in the context of emotional responses and highlight potential treatment targets to further improve adverse outcomes associated with PTSD and comorbidities.

Current Study

The objective of this study was to examine whether pre- to posttreatment changes in distinct trauma-cued emotional states were associated with pre- to posttreatment improvements in domains that are relevant to a dual diagnosis population: PTSD symptoms, depression, and negative urgency (impulsivity). First, we hypothesized that treatment-completers would report significant pre- to posttreatment decreases in the severity of trauma-cued emotions. Second, we proposed an exploratory aim to assess whether changes in trauma-cued emotional states would mediate pre- to posttreatment improvement in overall PTSD symptoms, depressive symptoms, and negative urgency. All participants reported abstinence during treatment (a requirement for continued participation in the program), thus treatment-related changes in substance use was not examined and impulsivity was included as an analogue for a substance-use outcome.

Method

Participants and Procedure

Participants were recruited after enrollment into the six-week residential day-treatment program in a well-established VA PTSD/SUD clinic in the Southeastern United States. All veterans met Diagnostic and Statistical Manual of Mental Disorders-IV-TR (DSM-IV-TR) diagnostic criteria for PTSD and a SUD as assessed by the MINI International Neuropsychiatric Interview (Sheehan et al., 1998) prior to treatment. Core treatment activities included weekly group sessions, and three individual sessions of CPT per week for a total of 15 sessions. A modified version of CPT with an emphasis on maladaptive thoughts related to trauma and substance use in the final three sessions was used. Veterans also participated in cognitive-behavioral therapy (CBT)-based group sessions that focused on the relation between PTSD and substance use four sessions per week, for a total of 24 sessions. This sample consisted of 72 veterans who completed treatment. Using the same dataset, Peck and colleagues (2018) found there were no significant group differences between veterans who completed treatment and those who did not regarding demographic variables and psychiatric measures. Five veterans were excluded through listwise deletion due to missing data at either pre- or posttreatment. The final sample for the present study was 67 veterans ($M_{age} = 49.39$, $SD = 10.77$; 97.0% men; 74.6% Black; 25.4% White). Most Veterans served in the Army (64.2%), followed by National Guard (10.4%), Air Force (9.0%), Marine Corps (9.0%), and Navy (7.5%). Combat-related trauma was the most commonly endorsed index trauma (44.8%), followed by physical assault (11.9%), and military sexual trauma (9.0%). Participants completed a battery of self-report measures that also included a trauma recall task, twice—once at enrollment into the program (i.e., pretreatment, T1) and again upon treatment completion (i.e., posttreatment, T2). This study was approved by the local IRB and written informed consent was obtained for all participants.

Measures

Trauma-Cued Negative Emotions. The Modified Differential Emotions Scale (MDES; Gross & Levenson, 1995) was used to assess the experience of eight state-level emotions following a trauma recall: anger toward oneself, anger at others, disgust toward oneself, disgust at others, fear, sadness, guilt, and shame. First, participants were instructed to provide a detailed verbal description of their worst traumatic event by a clinical interviewer. They were prompted to provide additional details by the interviewer throughout the recall task if they did not describe a clear, distinct event or if the description lacked sufficient detail for the interviewer to understand the event. Immediately following the trauma recall, participants rated how strongly they were currently experiencing each emotion on a 0 (*not at all*) to 5 (*extremely*) scale. Single item scores were used to represent eight separate emotional responses. The same recall procedure was used to assess trauma-cued state level emotions at pre- and posttreatment assessments.

PTSD Symptoms. The PTSD Checklist – Specific (PCL-S; Weathers, Litz, Herman, Huska, & Keane, 1993) is a 17-item questionnaire that assessed past-month DSM-IV PTSD symptoms with reference to the participants' self-identified most distressing traumatic event. Items were rated on a 1 (*not at all*) to 5 (*extremely*) scale and summed, with higher scores indicating greater symptom severity. Past work has demonstrated adequate validity and reliability with the PCL-S (Wilkins, Lang, & Norman, 2011). Cronbach's α in this study was .82 at the pretreatment assessment and .95 at the posttreatment assessment.

Depressive Symptoms. The 21-item Beck Depression Inventory-II (BDI-II; Beck, Steer, Ball, & Ranieri, 1996) assessed the severity of depressive symptoms over the past 2 weeks. Items were rated on a scale of 0 to 3 and summed, with higher scores indicating greater depressive symptom severity. Previous studies have demonstrated acceptable validity and internal consistency with this measure (Dozois, Dobson, & Ahnberg, 1998). Cronbach's α in this study was .92 at both pretreatment and posttreatment.

Negative Urgency. The 12-item negative urgency subscale from the UPPS-P Impulsive Behavior Scale (UPPS-P; Lynam, Smith, Whiteside, & Cyders, 2006) assessed the tendency to act impulsively in response to negative emotions. Items were rated on a 1 (*strongly agree*) to 4 (*strongly disagree*) scale and summed, with higher scores indicating greater impulsive behavior. Previous studies have found acceptable internal consistency with this subscale ($\alpha = .88$; Deckman & Nathan DeWall, 2011). Cronbach's α for negative urgency in this study was .72 at pretreatment and .83 at posttreatment.

Data Analysis

To test our first hypothesis, we examined whether eight trauma-cued emotions significantly decreased from pre- to posttreatment using paired samples t-tests. As a preliminary analysis, we also assessed for pre- to posttreatment changes in negative urgency with the same method because previously reported findings from this program evaluation study did not assess for significant decreases in negative urgency. Within-group Cohen's d effect size was used to quantify amounts of change. We interpreted Cohen's $d < 0.20$ as no change, and Cohen's d 's of 0.20, 0.50, and 0.80 as small, moderate, and large change, respectively.

For the exploratory aim, we assessed whether changes in trauma-cued negative emotions mediated pre- to posttreatment improvement in outcome variables (i.e., PTSD symptoms, depressive symptoms, and negative urgency) using a within-subjects mediation model (Judd, Kenny, & McClelland, 2001). Analyses were conducted using the Mediation and Moderation Analysis for Repeated Measures Design SPSS macro (MEMORE; Montoya & Hayes, 2017).

Difference scores for the eight MDES emotions (M_{1-8}) were entered simultaneously as mediators predicting difference scores for each outcome variables (Y ; see Figure 1); thus, three separate mediation models were run. Difference scores subtracted posttreatment scores from pretreatment scores; therefore, higher scores represented improvement. In a within-subjects mediation model that includes repeated measures for all variables, the independent variable (X) is representative of time between the two measurements (Montoya & Hayes, 2017). Because this study included pre- and posttreatment measures, X can be interpreted as completing treatment such that the a_{1-8} paths represent the mean difference or changes from pre- to posttreatment in MDES emotions, b_{1-8} paths represent the effect of pre- to posttreatment differences in MDES emotions on pre- to posttreatment differences in outcome variables, and the c' path represents the mean difference or changes in outcome variables. To account for between-subject variability, MEMORE also included person-mean scores (i.e., average of pre- and posttreatment scores for each participant) for each variable as covariates when predicting change scores in outcome measures. Mediation was tested using bootstrapping methods to calculate the indirect effect ($a*b$) for 10,000 samples (with replacement) from the dataset. Bootstrapping produces a sampling distribution of indirect effects with 95% confidence intervals and significance is indicated when the CIs do not contain zero. A significant indirect effect of the treatment on outcome scores would suggest the effect of improved outcome scores is in part mediated by changes in trauma-cued emotions. Furthermore, because all eight emotions were included as predictors for each outcome, a significant indirect effect for a given emotion indicates a mediation effect above and beyond the variability explained by changes in other emotions.

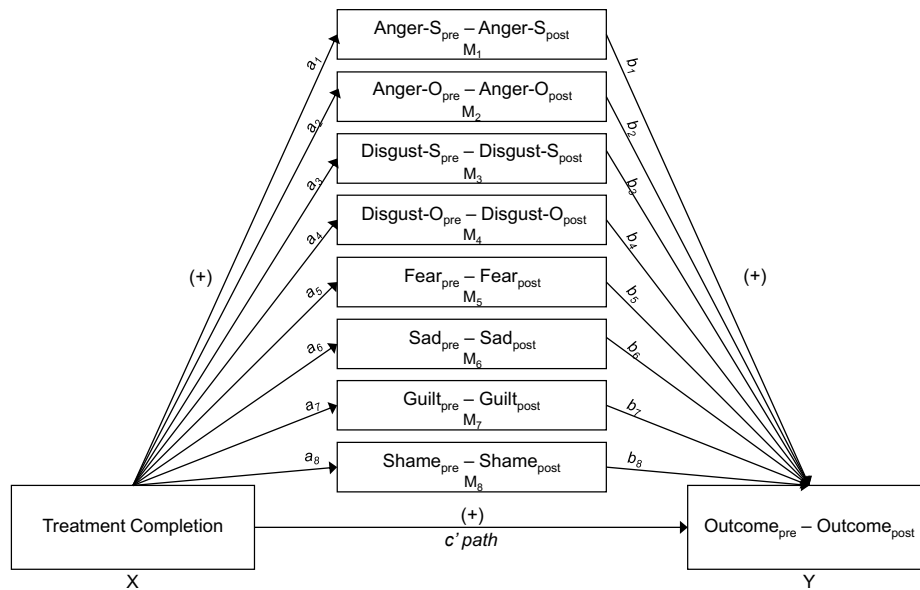


Figure 1. Within-subjects mediation model, with improvement in trauma-cued emotions mediating treatment outcome improvement from pre- to posttreatment. X indicates the time between pre- and posttreatment measures. Average repeated scores were added as covariates for predicting treatment outcome improvement (not shown in figure). S=at-self; O=at-others.

Results

Descriptive statistics at baseline and posttreatment are summarized in Table 1. First, preliminary analysis indicated that participants reported small significant decreases in negative

urgency, on average. As previously reported, participants also endorsed large significant decreases in PTSD and depressive symptoms. All negative emotions but three significantly decreased over the course of treatment; disgust at others, anger at others, and shame were not significant when corrected for potential Type I error. Moderate, significant decreases were found for anger at self, disgust at self, fear, guilt, and sadness. Small, nonsignificant decreases were found for anger at others and shame (see Table 1).

Table 1. Descriptives and results of paired-samples t-test of outcomes and mediators.

Treatment Outcomes	<i>M</i> (<i>SD</i>) Pre-tx	<i>M</i> (<i>SD</i>) Post-tx	<i>M</i> diff	<i>t</i>	<i>p</i>	<i>d</i>
PCL-S	66.19 (9.13)	49.61 (15.50)	16.58	8.60	<.001	1.05
BDI-II	30.79 (11.52)	17.43 (11.81)	13.36	8.83	<.001	1.08
UPPS-P Negative Urgency	33.76 (5.77)	31.45 (6.99)	2.31	2.86	.006	0.35
MDES Emotions						
anger at self	3.48 (1.67)	2.13 (1.55)	1.34	5.18	<.001	0.64
anger at others	3.57 (1.83)	2.84 (1.51)	0.73	2.45	.017	0.30
disgust at self	3.24 (1.93)	1.87 (1.60)	1.37	4.94	<.001	0.59
disgust at others	3.31 (1.91)	2.84 (1.62)	0.48	1.57	.122	0.19
fear	3.66 (1.54)	2.31 (1.59)	1.34	5.00	<.001	0.61
sad	3.75 (1.48)	2.73 (1.57)	1.01	4.13	<.001	0.51
guilt	3.27 (1.93)	1.97 (1.70)	1.30	4.59	<.001	0.56
shame	2.97 (2.10)	2.19 (1.73)	0.78	2.65	.010	0.33

Note: $n = 67$. Pre-tx = pretreatment score; post-tx = posttreatment score; *M* diff = mean difference score; PCL-S = Posttraumatic Checklist-Specific; BDI-II = Beck Depression Inventory-II; MDES = Modified Differential Emotions Scale. **Bolded** *p*-values indicate statistical significance with Bonferroni correction.

Results for each respective mediation model, testing PTSD, depression, and negative urgency as outcome variables are shown in Table 2. Changes in three trauma-cued emotions (i.e., sadness, self-directed disgust, and fear) mediated improvement in three of the outcomes (i.e., PTSD, depression, and negative urgency). Sadness demonstrated significant indirect effects for PTSD ($B = 3.59$, $SE = 1.32$, 95% CI = 1.33, 6.43), depression ($B = 2.14$, $SE = 0.91$, 95% CI = 0.58, 4.12), and negative urgency ($B = 1.13$, $SE = 0.60$, 95% CI = 0.10, 2.46). A significant indirect effect in this case indicates that changes in trauma-cued sadness accounted for a significant portion of improvement in these symptoms. Self-directed disgust ($B = 3.64$, $SE = 1.86$, 95% CI = 0.48, 7.71) demonstrated significant indirect effects for improvement in depression, as did fear ($B = 2.09$, $SE = 0.99$, 95% CI = 0.35, 4.20), but neither mediated PTSD or negative urgency. Neither shame, self-directed anger, other-directed anger, nor guilt mediated improvements in treatment outcomes.

Discussion

The objective of the study was to test whether improvements in trauma-cued emotions mediated pre- to posttreatment improvements in clinical targets (i.e., PTSD symptoms, depression symptoms, and negative urgency) in a clinically representative sample of dual diagnosis patients. Accordingly, the goals of this study were to enhance our understanding of

how reducing specific negative emotional experiences following a trauma reminder is associated with successful improvements in treatment outcomes and identify potential areas trauma treatment could improve upon.

Table 2. Within-Person Mediation Models Testing the Indirect Effects of Changes in Trauma-cued Negative Emotions on Pre- to Posttreatment Improvement ($n = 67$)

MDES	<u>ΔPCL-S</u>			<u>ΔBDI-II</u>			<u>ΔUPPS-P Negative Urgency</u>		
	<i>B</i>	<i>SE</i>	95% CI	<i>B</i>	<i>SE</i>	95% CI	<i>B</i>	<i>SE</i>	95% CI
1 Δanger-self	-1.35	1.77	-5.03, 2.07	-0.39	1.31	-3.09, 2.14	-1.12	0.94	-3.11, 0.62
2 Δanger-others	-0.63	1.07	-3.04, 1.40	-1.26	0.93	-3.43, 0.16	-0.13	0.54	-1.29, 0.94
3 Δdisgust-self	-0.55	2.27	-5.12, 3.94	3.64	1.86	0.48, 7.71	0.59	1.20	-1.73, 3.04
4 Δdisgust-other	1.02	0.97	-0.39, 3.31	0.56	0.63	-0.39, 2.09	0.32	0.43	-0.35, 1.35
5 Δfear	1.33	1.22	-0.94, 3.87	2.09	0.99	0.35, 4.20	0.17	0.63	-1.08, 1.46
6 Δsad	3.59	1.32	1.33, 6.43	2.14	0.91	0.58, 4.12	1.13	0.60	0.10, 2.46
7 Δguilt	2.59	1.72	-0.57, 6.25	0.65	1.21	-1.67, 3.13	-0.73	0.87	-2.54, 0.88
8 Δshame	0.77	0.81	-0.63, 2.60	-0.16	0.56	-1.33, 0.95	0.61	0.46	-0.11, 1.69

Note. Δ = Pre- to posttreatment change score, with positive scores indicating improvement; MDES = Modified Differential Emotion Scale; PCL-S = PTSD Checklist-Specific; BDI-II = Beck Depression Inventory-II; MDES = Modified Differential Emotions Scale; **Boldface** marks statistical significance indicated by 95% CIs that do not contain zero.

Overall, the potency of negative emotions immediately following a trauma cue significantly decreased after treatment. Medium decreases were seen for five emotions: sadness, fear, guilt, self-directed disgust, and self-directed anger. Small decreases were seen for three emotions: shame, other-directed disgust, and other-directed anger. These results support a core assumption of trauma-focused treatment: effective treatment will reduce the intensity of affective reactions or *being triggered* to trauma-related stimuli. The clinical implication is that veterans may experience significantly less emotional distress when faced with unexpected and often uncontrollable trauma reminders, which could positively affect their daily functioning. Decreased emotional distress following trauma reminders could be particularly beneficial for veterans who also struggle with substance use given that reported urges to use following strong negative emotions are higher for those with a dual diagnosis compared to individuals who have SUD, but not PTSD (Waldrop, Back, Verduin, & Brady, 2007).

There are clinically important, qualitative distinctions in the different expressions of these negative emotions in the context of trauma response and treatment. As examined in this study, the emotions of anger and disgust can be directed at either the self or another person, depending on attributions made about the event. Notably in this sample, results indicated medium, significant decreases in anger and disgust directed at the self, whereas changes in anger and disgust directed at others were minimal and nonsignificant. It should be noted that the pretreatment rating for both pairs were not remarkably different (e.g., disgust: $M_{self} = 3.24$, $M_{others} = 3.31$), yet only anger and disgust at the *self* decreased significantly at posttreatment. With replication, these results could suggest this cognitive-based PTSD treatment was better at reducing emotional distress based on negative attributions about the self versus others. Although it is not clear from this study if or how trauma-cued emotions directed at others impact veterans'

overall distress, perhaps more improvement in this area could influence perceptions of others in general and may have additional benefits such as impacting social functioning and engagement.

It is also interesting to note that anger and disgust at others align with the concept of moral injury—perpetrating or witnessing transgressive acts that violate one’s personal values and beliefs (Litz et al., 2009), which is believed to be a significant concern for many veterans given the sample’s exposure to high intensity combat. Anger, guilt, and shame are considered core components of emotional distress that comprise the moral injury syndrome (Frankfurt & Frazier, 2016). Anger at others, as measured in this study, could fall within that syndrome and would be especially relevant during morally injurious events in which someone reports significant betrayal by a trusted person (e.g., commanding officer; Jordan, Eisen, Bolton, Nash, & Litz, 2017). Speculatively, disgust at others may be particularly relevant following *witnessed* transgressive acts, such that one may experience moral-based disgust after seeing another person commit an act that significantly violates their personal values (e.g., witnessing mistreatment of corpses). Currently, there is a debate within the trauma literature as to whether cognitive-based treatments designed for PTSD, such as CPT, effectively target the complex, moral-based emotions that are associated with moral injury (Finlay, 2015; Gray, Nash, & Litz, 2017). In this sample of veterans with comorbid PTSD and SUD, the CPT-based program was less effective at reducing trauma-cued emotions directed at others, which may be relevant to veterans in this sample who primarily identified transgressive acts as their worst traumas vs. life-threat traumas. Although shame also demonstrated a minimal, nonsignificant decrease, there was a large, significant reduction in guilt; therefore, not all moral-based emotions were unaffected by this treatment. Shame and guilt may have different relationships with different types of traumatic experiences (Frankfurt et al., 2018). Admittedly, participants in this study were not screened for morally injurious event exposure and reported a wide range of trauma types, so it is unknown whether any of the measured emotions were in response to moral injury events. Further work is needed to determine the extent to which cognitive-based trauma treatments alleviate distressing moral emotions that might be treatment resistant in general or associated with moral injury for veterans exposed to combat trauma.

Our exploratory aim demonstrated mixed results across emotions. Sadness, self-directed disgust, and fear mediated the improvement in some, but not all, treatment outcomes. Specifically, reduced sadness following a trauma recall accounted for improvements in PTSD, depression, and impulsivity related to negative emotions; self-directed disgust and fear accounted for improvements in depressive symptoms. Changes in sadness accounted for the greatest amount of nonspecific improvements in affective, trauma-related, and substance-abuse related outcomes, which may indicate a multifinial transdiagnostic process (Nolen-Hoeksema & Watkins, 2011). Specifically, improvements in sadness may reflect improvements in the shared, nonspecific dysphoria and negative affect that may account for the high comorbidity of PTSD and depression (Post, Zoellner, Youngstrom, & Feeny, 2011). The result that improvements in self-directed disgust was associated with improvements in depression is consistent with previous studies that found self-directed disgust both preceded depression symptoms (Powell, Simpson, & Overton, 2013) and mediated dysfunctional cognitions and depression (Overton, Markland, Taggart, Bagshaw, & Simpson, 2008).

That improvements in fear was associated with depression but not PTSD is frankly unexpected and inconsistent with theoretical models of both PTSD pathogenesis and treatment recovery. We can speculate a number of potential contributing factors: it may be that the trauma recall exercise did not elicit an acute state-level fear response; it may be that men were underreporting their fear responses given stigma surrounding emotional disclosure; or it may be

that alleviating sadness was simply more salient for reducing overall trauma-related distress captured by the PCL-S in this sample. Future research should incorporate additional measurement methods to examine the effects of changes in trauma-cued fear in this population compared with other samples and examine differences in these changes across various trauma types with a larger sample size. Last, few studies have examined the association between negative trauma-cued emotions and impulsivity in an ecologically valid setting, despite its clinical relevance for those with PTSD and SUD. The result that improvements in sadness was associated with improvements in negative urgency may highlight one way in which trauma-focused treatment can directly benefit substance use-related outcomes.

The nonsignificant pathways also raise interesting questions about treatment targets and the impact of treatment. Improvements in trauma-related shame, self-directed and other-directed anger, and guilt did not account for improvements in PTSD, depression, or impulsivity. One possible explanation is that a reduction in these trauma-cued emotions is not essential to improved treatment outcomes. Perhaps reduced sadness—the emotion that was significant across all outcomes—is a core component of effective treatment in veterans with comorbid PTSD and SUD, and improvements in other emotional reactions are secondary or related to other outcomes that were not assessed in this study. It may be that other emotions did not demonstrate significant mediation effects because their reduction was due to a general lightening of negative affectivity, and so unique contributions of specific emotional reactions could not be parsed out. Individual differences in the relative prominence and salience of different trauma-cued emotions may account for these findings; for instance, guilt could mediate improvements in PTSD symptoms in veterans for whom guilt associated with the traumatic event played a central role in their case conceptualization. It seems likely that different trauma types are differentially associated with the various trauma-related emotions (Litz et al., 2018; Stein et al., 2012). Given that veterans in this sample reported a wide range of traumatic events (e.g., combat, MST, physical assault), group-level analyses may be obscuring meaningful within-group heterogeneity along the trauma-related emotions dimension. Notably, we cannot rule out that reduced emotions could be a function of repeated exposure to the cued-recall task or that changes in symptoms could proceed changes in emotions. Future studies should examine whether mediation effects for specific trauma-cued emotions differ across trauma types and include additional assessments of emotional states.

The results need to be interpreted in light of study limitations. First, the program evaluation study did not have a control or comparison condition; thus, we cannot conclude that changes are necessarily a function of the treatment itself. Second, we did not assess for state-level emotions prior to the trauma recall or with a separate control elicitor (e.g., a non-trauma-related cue), which limits the extent we can attribute state emotions as a consequence of the trauma recall task, exclusively. However, we used a within-subjects design that could partially account for innate characteristics to emotional reactivity that might influence responses. Although we cannot account for variability in mood or daily life stressors, which reduces internal validity, we propose that these findings are still valuable because they may be more ecologically valid given that veterans' emotional responses to trauma reminders in naturalistic settings are not isolated from their baseline mood or life stressors. Future research should examine these same processes with greater control and specificity to establish internal validity of these potential mechanisms. Given the limitations to single-item ratings, future studies should include robust measures of emotional responses to trauma reminders. Third, substance use was not an outcome because patients were required to remain abstinent throughout treatment; therefore, it's still

unclear if changes in trauma-cued emotions have a direct effect on substance use. Last, the program evaluation study was clinically representative of typical inpatient residential day treatment programs, thus there were few inclusion or exclusion criteria, such as current medication use or history of previous treatment. Future studies should include a comparison condition as well as extended posttreatment follow-up assessments to assess whether reduced emotional reactivity continues after treatment, whether it impacts continued abstinence or resumed substance use, and to test causal interpretations of the findings.

In conclusion, our findings suggested that veterans reported pre- to posttreatment decreases in a wide range of negative emotions following a trauma reminder and improvement in PTSD symptoms, depression symptoms, and impulsivity associated with negative emotions following a residential treatment program. Furthermore, reduced emotional reactivity to trauma cues accounted for some of the significant improvement in treatment outcomes within a dual diagnosis population, but only through specific negative emotions. This study offers a novel contribution by highlighting the potential role of reduced trauma-cued emotional distress in trauma treatment, particularly for veterans suffering from PTSD and SUD. This study also indicates areas of future research to better understand the processes of therapeutic change so we can continue to improve upon and maximize existing treatments.

DISCLOSURES

The authors declare no conflicts of interest with respect to the research, authorship, and/or publication of this article. The authors report no financial relationships with commercial interests.

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