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Research paper

Conceptualizing comorbid PTSD and depression among treatment-seeking, active duty military service members

John C. Moring[a,*], Erica Nason[b], Willie J. Hale[a,c], Jennifer Schuster Wachen[d,e], Katherine A. Dondanville[a], Casey Straud[a], Brian A. Moore[a,c], Jim Mintz[a,f], Brett T. Litz[e,g,h], Jeffrey S. Yarvis[i,1], Stacey Young-McCaughan[a], Alan L. Peterson[a,c,j], Patricia A. Resick[k], for the STRONG STAR Consortium

[a] Department of Psychiatry, University of Texas Health Science Center at San Antonio, San Antonio, TX, USA
[b] School of Social Work, Texas State University, San Marcos, TX, USA
[c] Department of Psychology, University of Texas at San Antonio, San Antonio, TX, USA
[d] National Center for PTSD, VA Boston Healthcare System, Boston, MA, USA
[e] Department of Psychiatry, Boston University School of Medicine, Boston, MA, USA
[f] Department of Epidemiology and Biostatistics, University of Texas Health Science Center at San Antonio, San Antonio, TX, USA
[g] Massachusetts Veterans Epidemiological Research and Information Center, VA Boston Healthcare System, Boston, MA, USA
[h] Department of Psychological and Brain Sciences, Boston University, Boston, MA, USA
[i] Department of Behavioral Health, Carl R. Darnall Army Medical Center, Fort Hood, TX, USA
[j] Research and Development Service, South Texas Veterans Health Care System, San Antonio, TX, USA
[k] Department of Psychiatry and Behavioral Sciences, Duke University Medical Center, Durham, NC, USA

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ABSTRACT

Background: Among active duty service members and veterans with PTSD, depression is the most commonly diagnosed comorbid psychiatric condition. More research is warranted to investigate the relationship between PTSD and depression to improve treatment approaches. Byllesby et al. (2017) used confirmatory factor analyses in a sample of trauma-exposed combat veterans with PTSD and found that only the general distress factor, and not any specific symptom cluster of PTSD, predicted depression. This study seeks to replicate Byllesby et al. (2017) in a sample of treatment-seeking active duty soldiers.

Methods: Confirmatory factor analyses, bifactor modeling, and structural equation modeling (SEM) were used with data gathered at pretreatment and posttreatment as part of a large randomized clinical trial.

Results: Confirmatory factor analyses and bifactor modeling demonstrated that PTSD symptom clusters, Negative Alterations in Cognition and Mood (NACM) and Alterations in Arousal and Reactivity (AAR), as well as the general distress factor significantly predicted depression at pretreatment and posttreatment.

Limitations: The current study was predominantly male, limiting the generalizability to female service members with PTSD. Also, self-report measures were used, which may introduce response-bias.

Conclusions: The current study did not replicate Byllesby et al. (2017). Results demonstrated that the relationship between PTSD and depression among active duty service members can be explained by both transdiagnostic factors and disorder-specific symptoms.

Abbreviations: AAR, alterations in arousal and reactivity; AV, avoidance; BDI-II, Beck Depression Inventory-II; CFA, confirmatory factor analysis; CFI, comparative fit index; CPT, Cognitive Processing Therapy; DSM-IV, Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition; GAD, generalized anxiety disorder; IN, intrusions; MDD, major depressive disorder; NACM, negative alterations in cognition and mood; OEF, Operation Enduring Freedom; OIF, Operation Iraqi Freedom; OND, Operation New Dawn; PCL, PTSD Checklist; PHQ-9, Patient Health Questionnaire-9; PTSD, posttraumatic stress disorder; PSS-I, PTSD Symptom Scale-Interview Version; RMSEA, root mean square error of approximation; SEM, structural equation modeling; WRMR, weighted root mean square residual

* Corresponding author.
E-mail address: moringj@uthscsa.edu (J.C. Moring).
[1] Jeffrey S. Yarvis is now at the 21st Combat Support Hospital, Fort Hood, TX, USA

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1. Introduction

The prevalence rate of posttraumatic stress disorder (PTSD) is approximately 14% among U.S. service members who have deployed in services of Operation Iraqi Freedom (OIF), Operation Enduring Freedom (OEF), and/or Operation New Dawn (OND; Hoge et al., 2004, 2006; Richardson et al., 2010). PTSD is associated with considerable comorbidity, most notably major depressive disorder (MDD; Rytwinski et al., 2013). A meta-analysis of 57 epidemiologic studies of service members and civilians indicated a very high rate of comorbid PTSD and MDD, with 52% of individuals who met diagnostic criteria for PTSD also meeting diagnostic criteria for MDD (Rytwinski et al., 2013). In this study, military service significantly predicted the rate of MDD among individuals with PTSD when outliers were removed from the model. Previous studies of U.S. veterans and active duty military personnel have found similar results, with depressive disorders accounting for the majority of the psychiatric conditions comorbid with PTSD (e.g., Gonzalez et al., 2016; Holliday et al., 2016; Kehle et al., 2011; Palmer et al., 2016; Servatius et al., 2017).

Individuals with PTSD and comorbid depression report significantly greater symptom severity and distress than individuals without a comorbid diagnosis (Gudmundsdottir et al., 2004; Ikin et al., 2010; Knowles et al., 2018; Sullivan et al., 2017). Comorbid depression also negatively impacts treatment outcomes among individuals who seek treatment for PTSD (Green et al., 2006; Steiner et al., 2017). Furthermore, comorbid depression and PTSD is associated with greater utilization of mental healthcare services, and costs for outpatient services (Chan et al., 2009; Possemato et al., 2010). Given these findings, it is important to understand the causal relationship between PTSD and depression and *how* these comorbid conditions may affect treatment outcomes in order to improve therapeutic approaches.

Researchers have posited several explanations for the high rates of comorbidity between PTSD and MDD. The firest entail a series of directional hypotheses, namely that pre-existing depression is a risk factor for combat-related PTSD or a diagnosis of PTSD is a risk factor for developing subsequent MDD). The second entails a common factor prediction, that is, PTSD and depression share common risk factors or vulnerabilities). The third suggests that comorbidity is an artifact of how the two disorders are assessed and categorized (Stander et al., 2014). The latter is particularly of not because there also is significant symptom overlap between PTSD and MDD (Ferrada-Noli et al., 1998), including changes in sleep patterns, negative beliefs about the self, irritability, loss of interest in enjoyable activities, and concentration problems (American Psychiatric Association, 2013).

A recent review found that there was no evidence to suggest that preexisting depression is a risk factor either for combat trauma or for PTSD following combat-related deployment experiences (Stander et al., 2014). However, some evidence suggests that PTSD is a risk factor for the development of depressive disorders (e.g., Wright et al., 2011). Their review also provided evidence to suggest that common factors and vulnerabilities likely contribute to the development of comorbid PTSD and depression, and yet these disorders remain distinguishable from one another.

With respect to common factors, there is conflicting evidence regarding which aspects of the PTSD syndrome account for the most variance in depressive symptoms. For example, the dysphoria factor of PTSD has been hypothesized to be a nonspecific factor of PTSD and more indicative of general distress and depressive symptoms. Using a four-factor confirmatory factor model of PTSD, Armour et al. (2011) found that, separately, symptoms of both MDD and generalized anxiety disorder (GAD) significantly attenuated the value of the factor loading of dysphoria items. However, this study used diagnostic criteria of PTSD from the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition* (DSM-IV; American Psychiatric Association, 1994), in which the PTSD factor of dysphoria included symptoms of sleep and concentration problems, anger and irritability, as well as hypervigilance and exaggerated startle responses. Alternatively, Brown and Barlow (2009) posited that there is significant symptom overlap and common general distress among all disorders. In the context of PTSD and depression, one study found that all DSM-IV-based symptom clusters were equally associated with depression (Marshall et al., 2010). It is important to recognize that the relationship between PTSD and MDD is heavily dependent upon the factor structure of PTSD included in data analyses. For example, one study demonstrated that a six factor model (Tsai et al., 2015), which includes a separate externalizing behavior factor, provided a good representation of PTSD symptoms.

More recent research has explored the relationship between PTSD and MDD using updated diagnostic criteria of PTSD from the *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition* (*DSM-5*; American Psychiatric Association, 2013) and more advanced statistical approaches. One such approach is bifactor modeling, which can be conducted in confirmatory factor analytic and item response theory frameworks (Reise et al., 2010). These models are useful insofar as they allow for nuanced partitioning of a construct's specific variance from its shared variance. In these models, each item is allowed to load onto its specific or subscale factor as well as a general bifactor, otherwise known as the “general distress factor.” The general distress factor can be conceptualized as a transdiagnostic factor common among psychological disorders (Krueger and Eaton, 2015; Sharp et al., 2015). The general distress factor is posited to encompass the elements of dysphoria that are present in mood and anxiety disorders and that are associated with a diagnosis of PTSD (Watson, 2009). Additionally, the bifactor model is specified in such a way that the resulting general distress factor is uncorrelated with any specific factors, all of which are also specified as uncorrelated with one another. To the extent that items load higher on the general factor as opposed to their respective specific factors, a case can be made for computing total scores, rather than subscale scores, for a multidimensional instrument. Moreover, model-based estimates of reliability, specifically coefficient omega, can be calculated and the amount of total and common variance accounted for by the general and specific factors can be obtained.

In a recent study, Byllesby et al. (2017) examined the relationship between PTSD and MDD using confirmatory factor analyses and bifactor model of PTSD using data from the PTSD Checklist for *DSM-5* (PCL-5; Weathers et al., 2013) and the Patient Health Questionnaire-9 (PHQ-9; Kroenke et al., 2001) for 683 veterans exposed to potentially traumatizing warzone events. A series of confirmatory factor analyses (CFAs) determined that the four factors of *DSM-5* PTSD and a single factor model of depression fit the data well. The initial CFA for PTSD allowed for the symptom cluster factors to correlate with one another, which resembles the typical and natural symptom presentation among individuals with PTSD. While this model fit the data well, it fit significantly worse than did a bifactor model of PTSD that included a general distress factor. Next, they examined two structural equation models (SEMs). In the first SEM, in which the four factors from the correlated symptom clusters model of PTSD were specified to predict depression, the negative alterations in cognition and mood (NACM) factor was the only factor that significantly predicted depression. However, when the factors in the bifactor model were specified to predict depression, NACM became nonsignificant, whereas the general distress factor was the sole significant predictor of depression (see Fig. 1). The results indicated that the general distress factor influences the comorbidity between PTSD and depression, rather than any of the four factors of PTSD.

Given the largely nonclinical sample used in the Byllesby et al. (2017) study, it remains unclear if these findings will generalize to clinically distressed patients. Participants in the Byllesby et al. (2017) were also assessed at one time point. As a result, the extent to which the relationship between PTSD symptom clusters and general distress changes over time and over the course of treatment remains unclear. The current study aims to extend the current literature

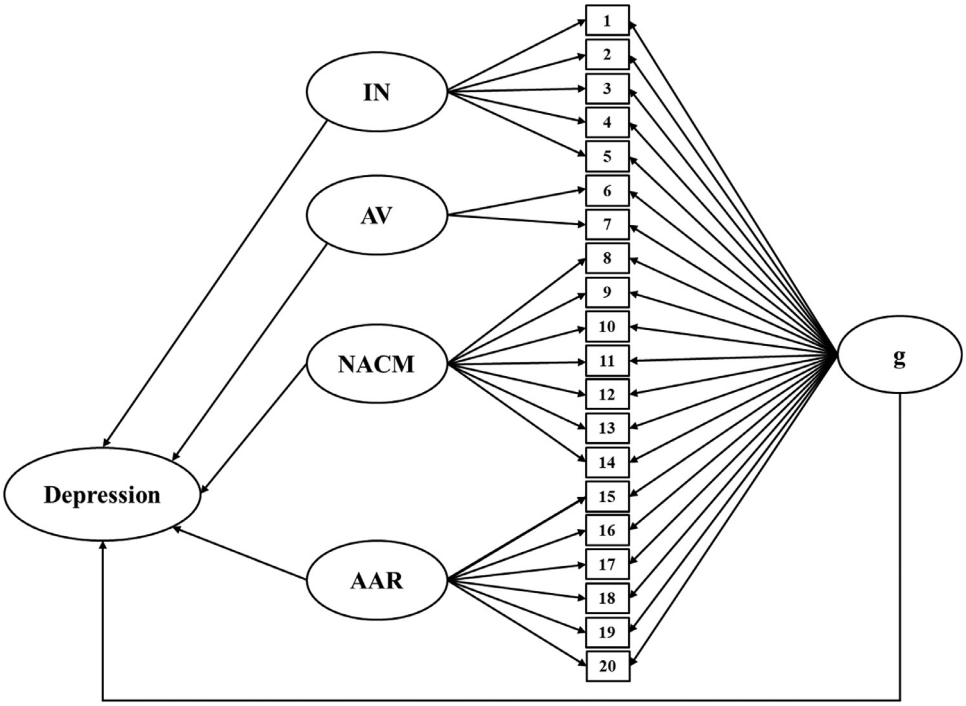

Fig. 1. General distress and *DSM-5* PTSD factors predicting latent depression factor. *DSM-5 = Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition*; IN = intrusion; AV = avoidance; NACM = negative alterations in cognition and mood; AAR = alterations in arousal and reactivity; *g* = general distress factor.

by addressing the aforementioned limitations in Byllesby et al. (2017) and by attempting to replicate the findings with a sample of active duty military personnel.

The current study is a secondary analysis of data from active duty service members with PTSD, who were randomized to receive either individual or group format of Cognitive Processing Therapy (CPT; Resick et al., 2017). Participants met with an independent evaluator to determine an index event for the target of treatment. PTSD self-report measures were indexed on the identified Criterion A trauma. Participants must have experienced a Criterion A event during a deployment, although noncombat-related traumas could be identified as the index event for treatment. Moreover, at the time of recruitment, all of the participants in the current study were required to meet criteria for PTSD during the independent evaluation with the PTSD Symptom Scale – Interview Version (PSS-I; Foa et al., 1993). The current study included analyses based on data gathered at both baseline and follow-up appointments, after participants received either Group CPT (Chard et al., 2009) or Individual CPT, without written trauma accounts, adapted specifically for military personnel and veterans (Resick et al., 2010). Restriction of range was an inherent problem at pretreatment because all participants had a likely diagnosis of PTSD and high scores on the PCL-5. However, by function of treatment, scores on the PCL-5 decreased at posttreatment, allowing for a wider range of PCL-5 scores. By examining both pre- and post-treatment data, issues related to restriction of symptom range at pretreatment can be examined. Consistent with Byllesby et al. (2017), we predicted that, (a) the bifactor model would fit the PCL-5 data better than would a correlated symptom clusters model at both pretreatment and posttreatment, and (b) within both assessment periods, only the general distress factor would predict contemporaneous depression scores.

2. Methods

2.1. Participants

Participants consented and were randomized into the parent study, a large randomized controlled trial (RCT; Resick et al., 2017) examining the efficacy of CPT delivered either in group format (Chard et al., 2009), or individual format (Resick et al., 2010). Participants (N = 268) included were age 18 or older, English-speaking, military service members stationed at Fort Hood, Texas, who had previously deployed in support of OIF/OEF/OND, who met criteria for PTSD on the PSS-I (Foa et al., 1993) administered by an independent and masked assessor. Exclusion criteria included suicidal or homicidal risk that required crisis intervention, active psychosis or mania, severe traumatic brain injury, or simultaneous treatment for PTSD. The mean pretreatment sample age was 33.18 (SD = 7.44), mostly male (91%), Caucasian (40%), married/cohabitating (70%), and enlisted (97%) in the Army (98%). Their military occupational specialty was fairly evenly distributed across Combat Arms (37%), Combat Support (24%), and Combat Service Support (39%) roles. The sample was ethnically diverse with large proportions of the sample identifying as Caucasian (40.3%), Black (28%), or Hispanic (23%). Seventy-four percent had attended at least some college. Full demographic information for the sample is included in Table 1.

2.2. Measures

The PTSD Checklist-5 (PCL-5; Weathers et al., 2013) evaluates how much participants have been bothered by PTSD symptoms in the past month as a result of traumatic events. The measure is divided into four subscales, including intrusion symptoms (IN), avoidance (AV), negative alterations in cognition and mood (NACM), and alterations in arousal and reactivity (AAR). A recent review reported this instrument demonstrates excellent internal consistency (α = 0.94), test-retest reliability (r = 0.82), and convergent (r = 0.74 to 0.85) and discriminant validity (r = 0.31 to 0.60; Blevins et al., 2015). In the current sample, coefficient alpha for the PCL-5 was 0.87 and 0.95 at pretreatment and posttreatment, respectively. For descriptive purposes, we categorized an individual as exhibiting probable PTSD symptoms using the same strategy employed by Byllesby et al. (2017) in order to maintain comparability with their findings and to avoid over-reporting PTSD prevalence in our sample. Specifically, they adapted the *DSM-IV* criteria algorithm developed by Cook et al. (2003) to indicate probable PTSD if

Table 1
Baseline demographic characteristics.

Characteristic	Total sample (N = 268)
Age	33.18 (7.44)
Male	244 (91%)
Married/Cohabitating	189 (71%)
Ethnicity	
Black	75 (28%)
Hispanic	62 (23%)
White	108 (40%)
Other	23 (9%)
Education	
High school or less	69 (26%)
Some college/Associate degree	178 (66%)
College/Graduate degree	21 (8%)
Army	263 (98%)
Enlisted rank	261 (97%)
Months in military	133.44 (76.08)
Typical duty	
Combat Arms	99 (37%)
Combat Support	64 (24%)
Combat Service Support	105 (39%)
Number of deployments	
1	74 (28%)
2	90 (34%)
3	55 (21%)
4+	47 (18%)

Note. Age and months in the military are presented with means and standard deviations. All other variables are presented with counts and percentages.

an individual endorsed (i.e., scored 2 “moderately affected” or higher) on at least one item from the intrusion subscale, one item from the avoidance subscale, and two items each from the negative alterations in cognitions and mood and the alterations in arousal and reactivity subscales on the PCL- 5.

The Beck Depression Inventory- Second Edition (BDI-II; Beck et al., 1996) consists of 21 items that assess both affective and somatic symptoms related to depression and depressive disorders. Each item is composed of four statements that reflect symptom severity. The BDI-II has high internal consistency ($\alpha = 0.89$), and convergent ($r = 0.75$) and discriminant validity ($r = 0.68$ to 0.71; Lee et al., 2017). In the current sample, coefficient alpha for the BDI-II was 0.92 and 0.96 at pretreatment and posttreatment, respectively. For descriptive purposes, we categorized individuals as exhibiting minimal to mild, moderate, or severe depressive symptoms if they scored lower than 20, between 20 and 28, and above 29, respectively.

2.3. Procedure

Participants were recruited from referrals by military providers located at Fort Hood, Texas, or from advertisements posted throughout the community. After completion of eligibility and baseline assessments, including the PCL-5 and the BDI-II, eligible participants were randomly assigned to receive either Group CPT or Individual CPT. Group CPT consisted of twice weekly sessions for 6 weeks, each lasting 90 min. Individual CPT consisted of twice weekly sessions for 6 weeks, each lasting 50–60 min. At the end of the 12 sessions, a posttreatment follow-up assessment was scheduled, which included the PCL-5 and the BDI-II. Please refer to Resick et al. (2017) for details regarding the procedures of the parent study.

2.4. Data analytic strategy

Two separate series of five CFAs/SEMs (one for pretreatment data and one for posttreatment data) were examined, mirroring the approach adopted in Byllesby et al. (2017) using MPlus version 7.2 (Muthen and Muthen, 2012). The first model in each series consisted of a correlated symptom clusters CFA measurement model of the four factors comprising the *DSM-5* PTSD diagnostic criteria (hereafter referred to as Model 1). The correlated symptom clusters model was then compared to the second model, a bifactor model of PTSD. As in Byllesby et al., for our bifactor measurement model (hereafter referred to as Model 2), each of the specific factors of PTSD (IN, AV, NACM, AAR) were uncorrelated with the general distress factor and with one another. Given that the correlated symptom clusters model and the bifactor model are nested, a chi-square difference test was used to determine which one better represents the underlying structure of the PCL-5. Additionally, for the bifactor models we calculated the percentage of the total and common variance accounted for by each of the factors as well as model-based estimates of reliability (coefficient omega; McDonald, 1999). The third model we examined was a unidimensional CFA of the BDI-II (Beck et al., 1996), hereafter referred to as Model 3. The fourth and fifth models were SEMs linking depression (outcome) to the correlated symptom clusters model and bifactor model of PTSD (predictors), respectively. These models are referred to as Model 4 and Model 5 hereafter. Given the response scales of the PCL-5 and the BDI-II, we treated the data as ordinal and estimated models using weighted least square mean and variance adjusted estimation. Model fit was deemed excellent if comparative fit index (CFI) values were > 0.95, root mean square error of approximation (RMSEA) values < 0.06 (Hu and Bentler, 1999) and weighted root mean square residual (WRMR) values were close to 1 (Yu and Muthen, 2002). As in Byllesby et al. (2017), parameter estimates from both SEMs were compared to examine the degree to which the PTSD symptom factors predicted depression, both before and after accounting for a general distress factor.

3. Results

3.1. Descriptive information

The mean PCL-5 score was 44.65 ($SD = 12.59$) and 34.50 ($SD = 19.33$) at baseline and posttreatment, respectively. Though all participants met criteria for PTSD based on the PSS-I, only 82% met criteria based on the aforementioned adapted diagnostic criteria for PTSD on the PCL-5 (100% if a score of 1 was used to define the cutoff for each symptom). Only 49% met *DSM-5* criteria at posttreatment based on the same adapted criteria using the PCL-5. BDI-II scores averaged 29.35 ($SD = 11.31$) at baseline and 22.01 ($SD = 14.89$) at posttreatment. Exactly 50% of the sample exhibited severe depressive symptoms at baseline, whereas 28% and 22% exhibited moderate and minimal to mild symptoms, respectively. At posttreatment, 32% exhibited severe depressive symptoms, 20% exhibited moderate symptoms, and 48% exhibited minimal to mild symptoms. PCL-5 and BDI-II scores were significantly correlated at both pre-treatment ($r(259) = 0.68$, $p < 0.001$) and post-treatment $r(158) = 0.75$, $p < 0.001$).

3.2. Pretreatment analyses

3.2.1. Measurement models

Fit statistics for all models discussed hereafter are presented in Table 2. All fit statistics were better at posttreatment compared to pretreatment, possibly due to restriction of range in the pretreatment data. At baseline, the correlated symptom clusters measurement model (Model 1) demonstrated suboptimal fit to the data (see top half of Table 2). The second model we tested, the bifactor model (Model 2), fit the data well per all prespecified criteria (CFI = 0.94, RMSEA = 0.076, WRMR = 1.06) and represented a significant improvement in model fit compared to the correlated symptom clusters model (χ^2 difference (14) = 207.35, $p < .001$), providing support for our first hypothesis that the bifactor model would fit the PCL-5 data better than a correlated symptom clusters model. Standardized factor loadings and model-based

Table 2
Fit statistics for study models.

Models	χ^2	df	CFI	RMSEA [90% CI]	WRMR
Pretreatment analyses					
Measurement models					
Model 1: Correlated symptom clusters (PCL-5)	587.69	165	0.88	.099 [.090–0.108]	1.42
Model 2: Bifactor model (PCL-5)	380.34*	151	0.94	.076 [.067–0.086]	1.06
Model 3: Unidimensional model (BDI-II)	498.90	186	0.94	.079 [.071–0.088]	1.19
Structural Models					
Model 4: Correlated symptom clusters (PCL-5)/Unidimensional (BDI-II)	1608.08	767	0.91	.064 [.060–0.068]	1.37
Model 5: Bifactor model (PCL-5)/Unidimensional (BDI-II)	1383.88*	752	0.93	.056 [.051–0.061]	1.21
Posttreatment analyses					
Measurement models					
Model 1: Correlated symptom clusters (PCL-5)	355.19	165	0.97	.085 [.073–0.098]	0.92
Model 2: Bifactor model (PCL-5)	268.63*	151	0.99	.070 [.056–0.084]	0.74
Model 3: Unidimensional model (BDI-II)	393.04	180	0.98	.083 [.072–0.095]	0.99
Structural models					
Model 4: Correlated symptom clusters (PCL-5)/Unidimensional (BDI-II)	1227.11	761	0.97	.060 [.054–0.066]	1.06
Model 5: Bifactor model (PCL-5)/Unidimensional (BDI-II)	1154.99*	746	0.97	.057 [.050–0.063]	0.99

Note. df = degrees of freedom; CFI = comparative fit index; RMSEA = root mean square error of approximation; CI = confidence interval; WRMR = weighted root mean square residual; PCL-5 = PTSD Checklist for *DSM-5*; BDI-II = Beck Depression Inventory-II.
* Statistically different ($p < .001$) from previous model.

Table 3
Standardized factor loadings from the PTSD-MDD bifactor model at pretreatment and posttreatment.

	Pretreatment analyses					Posttreatment analyses				
Item	IN	AV	NACM	AAR	G	IN	AV	NACM	AAR	G
1. Intrusive thoughts	.58				.50	.47				.83
2. Nightmares	.44				.35	.48				.70
3. Reliving trauma	.32				.57	.47				.77
4. Emotional cue reactivity	.21				.66	.21				.86
5. Physiological cue reactivity	.21				.57	.25				.82
6. Avoidance of thoughts		.60			.57		.42			.84
7. Avoidance of external reminders		.60			.56		.43			.83
8. Trauma-related amnesia			−0.02		.30			.01		.56
9. Negative beliefs			.24		.62			.19		.78
10. Distorted blame			.12		.53			.10		.61
11. Persistent negative emotional state			.11		.68			.03		.89
12. Lack of interest			.65		.49			.43		.82
13. Feeling detached			.72		.53			.50		.79
14. Unable to feel positive emotions			.66		.52			.56		.73
15. Irritability/anger				−0.04	.56				.09	.67
16. Recklessness				−0.16	.54				.14	.54
17. Hypervigilance				.54	.57				.36	.74
18. Easily startled				.86	.51				.70	.64
19. Difficulty concentrating				.01	.57				.04	.77
20. Difficulty sleeping				.05	.45				.10	.64
% Total Variance	7.3	3.2	10.0	8.6	19.8	3.8	1.8	4.0	3.3	55.9
% Common Variance	15.0	6.5	20.5	17.5	40.5	5.6	2.7	5.8	4.8	81.2
Coefficient Omega	$\omega_s = 0.54$	$\omega_s = 0.38$	$\omega_s = 0.58$	$\omega_s = 0.67$	$\omega_h = 0.88$	$\omega_s = 0.17$	$\omega_s = 0.20$	$\omega_s = 0.10$	$\omega_s = 0.10$	$\omega_h = 0.97$

Note. PTSD = posttraumatic stress disorder; MDD = major depressive disorder; IN = intrusion; AV = avoidance; NACM = negative alterations in cognition and mood; AAR = alterations in arousal and reactivity; *G* = general distress; ω_h = omega hierarchical; ω_s = omega subscale.

estimates of reliability (coefficient ω) from the pretreatment bifactor models are presented in Table 3. For the pretreatment data, only the general factor exhibited satisfactory reliability, coefficient ω = 0.88; it also accounted for the largest proportion of the total variance (19.8%) and common variance (40.5%) among the items, nearly twice as much as any of the specific factors. The third and final measurement model, a unidimensional model for the BDI-II (Model 3), initially did not fit the data as well as expected, but fit was improved to acceptable levels with the additional modeling of three residual covariances.

3.2.2. Structural models

After establishing satisfactory measurement models for the PCL-5 and the BDI-II, we tested two SEMs, both of which demonstrated acceptable fit to the data. Regression coefficients from both SEMs are presented in Table 4. The first SEM used each of the *DSM-5* factors in the correlated symptom clusters model to predict the latent depression factor (Model 4). Results of this model indicated that the NACM factor was significantly associated with depression ($B = 1.15$, $p < .001$), as was the AAR factor ($B = 0.38$, $p = .005$). The correlated symptom clusters specification accounted for 66.30% of the variability in depressive symptomatology. The second SEM specified all of the factors in the bifactor model of PTSD as predictors of depression (Model 5); this model fit the data significantly better than did the previous model (χ^2 difference (15) = 224.20, $p < .001$). Results indicated that the general distress factor was associated with depression ($B = 1.94$, $p < .001$), as predicted; however, it was not the only significant predictor in the model. Even when accounting for the general distress factor, both NACM ($B = 0.99$, $p < .001$) and AAR were associated with depression ($B = -0.56$, $p = .009$). This model accounted for 84.20% of the variability in depressive symptomatology. Given that the R^2 for this model was so robust, we conducted a supplementary analysis on a modified version of Model 5 in which we constrained the paths of the

Table 4
DSM-5 PTSD factors and general factor predicting depression. .

Models	*B*	*90% CI*	*SE*	*β*	*p*
Pretreatment analyses					
Regression results without a specified general factor					
IN	−0.07	−0.51 to 0.38	0.17	−0.04	.71
AV	0.04	−0.30 to 0.39	0.13	0.03	.74
NACM	1.15	0.81 to 1.49	0.13	0.67	<0.001
AAR	0.38	0.03 to 0.72	0.13	0.22	0.005
Model R^2	66.30%				
Regression results including general distress factor					
IN	−0.42	−1.04 to 0.21	0.24	−0.17	.09
AV	−0.33	−0.88 to 0.21	0.21	−0.13	0.11
NACM	0.99	0.39 to 1.57	0.29	0.39	<0.001
AAR	−0.56	−1.12 to −0.01	0.22	−0.22	.009
G (bifactor)	1.94	0.83 to 3.05	0.43	0.77	<0.001
Model R^2	84.20%				
Posttreatment analyses					
Regression results without a specified general factor					
IN	0.18	−0.41 to 0.76	0.23	0.10	.43
AV	0.26	−0.24 to 0.75	0.19	0.15	.19
NACM	0.62	0.17 to 1.07	0.17	0.37	<0.001
AAR	0.41	−0.16 to 0.97	0.22	0.24	.06
Model R^2	65.20%				
Regression results including general distress factor					
IN	−0.03	−0.35 to 0.30	0.12	−0.01	.84
AV	0.00	−0.28 to 0.28	0.10	0.00	.99
NACM	0.29	0.01 to 0.57	0.10	0.15	.008
AAR	−0.43	−0.87 to −0.01	0.16	−0.23	.01
G (bifactor)	1.54	0.89 to 2.20	0.25	0.81	<0.001
Model R^2	72.60%				

Note. *DSM-5 = Diagnostic and Statistical Manual for Mental Disorders, Fifth Edition*; PTSD = posttraumatic stress disorder; CI = confidence interval; SE = standard error; IN = intrusion; AV = avoidance; NACM = negative alterations in cognition and mood; AAR = alterations in arousal and reactivity; *G* = general distress factor.

specific factors to zero so that we could determine how much variance that only general factor itself was accounting for. This model fit the data well, but did fit significantly worse than the original Model 5 (χ^2 difference (4) = 93.46, $p < .001$); however, the general factor accounted for 66.20% of the variance in BDI-II scores. That is, the specific factors did improve model fit, but accounted for relatively little variance compared to the general factor (R^2 change = 18.0%).

3.3. Posttreatment analyses

3.3.1. Measurement models

Results from all posttreatment analyses are presented alongside those from their pretreatment counterparts in Tables 2, 3, and 4. At posttreatment, the correlated symptom clusters model (Model 1) exhibited satisfactory model fit (see Table 2), but the bifactor model (Model 2) fit the data significantly better (χ^2 difference (14) = 86.56, $p < .001$). Standardized factor loadings and model-based estimates of reliability (coefficient ω) from the posttreatment bifactor models are presented in Table 3. For the posttreatment data, only the general factor exhibited satisfactory reliability, coefficient ω = 0.97; it also accounted for the largest proportion of the total variance (55.9%) and common variance (81.2%). The unidimensional measurement model for the BDI-II (Model 3) also exhibited satisfactory fit to the data.

3.3.2. Structural models

We examined the same two structural models for the posttreatment data that we did for the pretreatment data, and much of the same pattern of results were observed, although the posttreatment models exhibited much better model fit. The SEM with the correlated factors predicting depression (Model 4) fit the data well, and results indicated that only the NACM factor ($B = 0.62$, $p < .001$) was associated with depression. This model accounted for 65.20% of the variability in depressive symptomatology. The second SEM with the factors from the bifactor model predicting depression (Model 5) fit the data significantly better than did the prior model (χ^2 difference (15) = 72.12, $p < .001$). Results from this model indicated that the general factor ($B = 1.54$, $p < .001$) was associated with depression, but that the NACM ($B = 0.29$, $p = .008$) and the AAR ($B = -0.43$, $p < .01$) factors were as well. Overall, this model accounted for 72.60% of the variability in depressive symptomatology. Again, we conducted a supplementary analysis on a modified version of Model 5 in which we constrained the paths of the specific factors to zero so that we could determine how much variance that only the general factor itself was accounting for. This model fit the data well, but did fit significantly worse than the original Model 5 (χ^2 difference (4) = 10.69, $p = .03$); however, the general factor accounted for 67.70% of the variance in BDI-II scores. As with the pretreatment analyses, the specific factors did improve model fit, but accounted for relatively little variance compared to the general factor (R^2 change = 4.90%).

4. Discussion

The purpose of this study was to examine whether the findings from Byllesby et al. (2017) could be generalized to a c linical sample of PTSD patients seeking treatment for PTSD and to test whether there is temporal stability in the findings over the course of treatment. Consistent with Byllesby et al. (2017), we found that the bifactor model fit the PCL-5 data significantly better than the correlated symptom clusters model at both pretreatment and posttreatment. Additionally, the general factor accounted for most of the common and shared variance in the PCL-5 scores, and it also accounted for most of the variability when predicting BDI-II scores at both assessments. These results underscore that general distress is a common factor associated with PTSD and MDD.

We also found different results from the findings of Byllesby et al. (2017). First, at pretreatment, and not accounting for the general distress factor, both Symptom Cluster D (negative alterations in cognition and mood; NACM) and Symptom Cluster E (alterations in arousal and reactivity; AAR) were significantly associated with depressive symptoms. Second, after accounting for the general distress factor at pretreatment, the general distress factor was not the only predictor significantly associated with depression; NACM and AAR were as well.

There are several possible explanations can account for the differences observed in this study compared to Byllesby et al. (2017). As other researchers have noted, there is significant overlap between symptoms of major depressive disorder (e.g. Flory and Yehuda, 2015) and the new DSM-5 subcluster of NACM may be a primary driver of this relationship. In the current study, at pretreatment participants met diagnostic criteria for PTSD based on a recommended PCL-5 cut-off score between 30 and 34 (Bovin et al., 2016). Participants in this study had a mean PCL-5 score of 44.65 (*SD* = 12.59), and 78% of participants exhibited moderate to severe depressive symptoms. In comparison and, not surprisingly, the epidemiological sample in Byllesby et al. consisted of individuals who were notably less symptomatic, considering their mean PCL-5 score was 28.60 (*SD* = 14.19), with only 9.2% meeting criteria for PTSD, and only 14.3% meeting criteria for a probable diagnosis of major depressive episode. The symptom presentation of the sample within the current study more accurately represents individuals seeking treatment for PTSD in clinical settings. Because our clinical sample was more symptomatic, it is possible that the results may be a function of a restricted range of both PCL-5 and BDI-II scores. However, post-treatment scores had more range.

At posttreatment, when not accounting for the general distress factor, only NACM was significantly associated with depression scores on the BDI-II. These results are consistent with Byllesby et al. (2017) and may be due to a wider range in both PCL-5 and BDI-II scores than in the pretreatment models. As noted in the parent study (Resick et al.,

2017), 37% of individuals who received Group CPT and 49% of individuals who received Individual CPT no longer met criteria for PTSD at posttreatment follow-up. However, after accounting for the general distress factor at posttreatment, similar findings were observed compared to the pretreatment results. Both NACM and AAR were significantly associated with depression, along with the general distress factor. Therefore, it is reasonable to suggest that NACM, AAR, and general distress are significant contributors to the high comorbidity between PTSD and depression among active duty military service personnel who meet criteria for PTSD. Although a significant proportion of participants in our sample no longer met diagnostic criteria for PTSD at posttreatment, individuals with subthreshold levels of PTSD often continue to experience impairments in functioning (Cukor et al., 2010), which may explain the contributions of the general distress factor at posttreatment.

The results of this study, although not predicted, were not surprising. Previous studies have demonstrated significant relationships between both NACM/AAR symptoms and depression (Armour et al., 2011; Boelen et al., 2008; Contractor et al., 2014; Elklit et al., 2010). It may be that evidence-based therapies for PTSD that target erroneous and dysfunctional trauma-related beliefs (e.g., CPT; Resick et al., 2017) and conditioned fear and safety-and competence-related beliefs (e.g., Prolonged Exposure; Foa et al., 2007) also demonstrate significant decreases in depression (Aderka et al., 2011; Asamsama et al., 2015; Goodson et al., 2013; Haller et al., 2016; Iverson et al., 2015; Liverant et al., 2012; McLean et al., 2015; Nishith et al., 2005) because these therapies each target NACM, which is the putative common factor. These therapies may have even greater impact on comorbid depression if they target not only trauma-related beliefs and experiences but depressionogenic ones as well (e.g., “I am to blame for my traumatic event happening;” “I don't deserve to do nice things for myself;” “if people knew about my trauma, they wouldn't like me”).

Interestingly, at both pretreatment and posttreatment, the direction of the beta coefficient of AAR was reversed depending on whether the general distress factor was accounted for in the analyses. Without the general distress factor, increases in scores associated with AAR significantly predicted increases in depressive symptoms. However, when accounting for the general distress factor, increased AAR scores were significantly predictive of decreases in depressive symptoms. After removing general arousal/distress that is found in the cluster, AAR is left with reactivity such as angry outbursts or self-harm behavior. It may be that to the extent that evidence-based treatments change these unique arousal-related behaviors they collaterally as a result improve depression.

This study is not without limitations. Though we aimed to address limitations outlined in Byllesby et al. (2017) by examining treatment-seeking active duty military personnel with a diagnosis of PTSD, the current study lacked representation of female active duty military personnel. It is possible that symptom presentation and the relationship between PTSD and depression differ between male and female active duty service members, and more research is warranted to address this empirical question. Similarly, 97% of the current sample were enlisted soldiers. Prior research has demonstrated important differences in demographic and military variables between enlisted soldiers and officers, including combat exposure (Mayo et al., 2013), likelihood of a PTSD diagnosis (Xue et al., 2015), alcohol use (Mattiko et al., 2011), and education (Department of Defense, 2015). Additionally, the measures used in the data analyses were based on self-report measures for *DSM-5*, which may increase the likelihood of response bias and differences due to the changes in the diagnostic measures. Also, because all participants in this study were PTSD symptomatic, and most participants reported symptoms of moderate to severe depression, results observed at pretreatment may be influenced by restriction of range of scores on both the PCL-5 and the BDI-II. However, the issue of restriction of range was addressed by examining posttreatment scores, at which point significant decreases in PTSD and depression were observed (Resick et al., 2017).

Finally, it is important to note that our SEMs were useful in establishing associations between these variables; they do not provide evidence of causality, which can only be done using experiments and/or longitudinal data. Though it was analytically possible to attempt to establish causality from this dataset using a cross lagged regression model we did not do so, 1) because of our primary goal of replicating and extending the findings of Byllesby et al. (2017), and 2) because of concerns about whether the same associations would be observed at both pre- and posttreatment given the restriction of range at the pretreatment assessment. We felt it was valuable first to establish these relationships cross-sectionally and to allow future research to more fully assess the issues of causality with datasets with more timepoints, especially because such data would allow for testing the degree to which these constructs are dynamically related over time. Moreover, theoretically and based on previous research (e.g., Stander et al., 2014), it is more likely that a) previous depression or predisposition to depression may influence whether individuals develop PTSD after a traumatic event; or b) there are similar underlying etiologies of both disorders. Longitudinal studies are warranted to empirically test these hypotheses.

The current study demonstrated that models including the bifactor specification of PTSD (i.e., models that include a general factor that all items load onto) were a better fit than models that use a correlated symptom clusters specification, both at pretreatment and posttreatment. When the bifactor was accounted for in predicting depression, NACM, AAR, and the bifactor were all significantly associated with depressive symptoms at both pretreatment and posttreatment timepoints. It is important to recognize that these results are unique to mostly male, active duty service members seeking treatment for PTSD. Results of this study support the notion of underlying transdiagnostic factors that are shared between PTSD and depression, as well as symptoms unique to both conditions.

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Conflicts of interest

The authors have no conflicts of interest.

CRediT authorship contribution statement

John C. Moring: Conceptualization, Writing - review & editing. **Erica Nason:** Conceptualization, Writing - review & editing. **Willie J. Hale:** Formal analysis, Writing - review & editing. **Jennifer Schuster Wachen:** Project administration, Writing - review & editing. **Katherine A. Dondanville:** Project administration, Writing - review & editing. **Casey Straud:** Formal analysis, Writing - review & editing. **Brian A. Moore:** Formal analysis, Writing - review & editing. **Jim Mintz:** Formal

analysis, Writing - review & editing. **Brett T. Litz:** Project administration, Writing - review & editing. **Jeffrey S. Yarvis:** Project administration, Writing - review & editing. **Stacey Young-McCaughan:** Project administration, Writing - review & editing. **Alan L. Peterson:** Project administration, Writing - review & editing. **Patricia A. Resick:** Conceptualization, Project administration, Writing - review & editing.

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