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## Research report

## Exploring the relationship between underlying dimensions of posttraumatic stress disorder and depression in a national, trauma-exposed military sample

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## ABSTRACT

**Background:** Posttraumatic stress disorder (PTSD) and depression are highly comorbid and intercorrelated. Yet little research has examined the underlying processes explaining their interrelationship.

**Method:** In the present survey study, the investigators assessed the combined symptom structure of PTSD and depression symptoms, to examine shared, underlying psychopathological processes. Participants included 740 Canadian military veterans from a national, epidemiological survey, previously deployed on peacekeeping missions and administered the PTSD Checklist and Center for Epidemiological Studies-Depression Scale (CES-D).

**Results:** An eight-factor PTSD/depression model fit adequately. In analyses validating the structure, PTSD's dysphoria factor was more related to depressive affect than to several other PTSD and depression factors. Somatic problems were more related to dysphoria than to other PTSD factors.

**Limitations:** Only military veterans were sampled, and without the use of structured diagnostic interviews.

**Conclusions:** Results highlight a set of interrelationships that PTSD's dysphoria factor shares with specific depression factors, shedding light on the underlying psychopathology of PTSD that emphasizes dysphoric mood.

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## 1. Introduction

Studies demonstrate that major depressive disorder (MDD) and PTSD are highly comorbid and statistically correlated, despite some symptom overlap. Studies have not

examined the individual, underlying structural dimensions of both PTSD and depression to explore their associations.

PTSD has clear conceptual and empirical ties to depressive disorders. Based on nationally representative studies, 48–55% of individuals diagnosed with a lifetime history of PTSD were also diagnosed with lifetime major depression (Elhai et al., 2008; Kessler et al., 1995). The substantial PTSD-depression comorbidity persists, even after removing items that overlap between the disorders, in large-scale epidemiological studies of adult civilians (Elhai et al., 2008) and military veterans (Grubaugh et al., 2010). Furthermore, among the most widely used PTSD instruments, relationships with depression

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severity range from .61 to .75 for the Clinician-Administered PTSD Scale (CAPS; reviewed in [Weathers et al., 2001](#)), and from .63 to .67 for the Posttraumatic Stress Disorder Checklist (PCL; e.g., [Adkins et al., 2008](#)).

The most empirically supported structural PTSD models ([Elhai and Palmieri, 2011](#); [Yufik and Simms, 2010](#)) were developed by [King et al. \(1998\)](#) and [Simms et al. \(2002\)](#). King et al.'s emotional numbing model involves four intercorrelated factors, separating the *DSM-IV* PTSD model's avoidance and numbing factors, in addition to reexperiencing and hyperarousal ([King et al., 1998](#)). Simms et al.'s dysphoria model revises King et al.'s model by moving PTSD's sleep disturbance, irritability, and impaired concentration symptoms from the hyperarousal to emotional numbing factor, reconceptualizing this factor as general dysphoria or distress ([Simms et al., 2002](#)). We focus here on the dysphoria model, given its large dysphoria factor which is conceptually and empirically related to depression.

Regarding depression's factor structure, we focus on the original 20-item Center for Epidemiological Studies-Depression Scale (CES-D) ([Radloff, 1977](#)), used in the present study. The four-factor CES-D model includes depressive affect, positive affect, somatic complaints and retarded activity, and interpersonal problems ([Radloff, 1977](#)). Research studies have most consistently supported this CES-D model (e.g., [Nguyen et al., 2004](#); [Sheehan et al., 1995](#)).

Some studies have found unique associations for PTSD's dysphoria factor with depression ([Simms et al., 2002](#)) and emotional distress ([Forbes et al., 2010](#)); others failed to replicate this finding ([Elklit et al., 2010](#); [Marshall et al., 2010](#); [Miller et al., 2010](#)). Examining this issue by using latent dimensions for both PTSD and depression represents a unique contribution in providing improved precision in measuring the disorders' factors, further refining our understanding of the shared psychopathological processes behind PTSD and depression.

The current study aimed to test the joint factor structure of PTSD and depression using the the PCL and CES-D, with a sample of war-zone exposed military veterans. Specifically, it was hypothesized that based on analyses validating the symptom structure, depression's depressive affect and somatic complaint factors would be more related to PTSD's dysphoria factor than to other PTSD or depression factors, given the relationship between dysphoria (which includes somatic distress) with depressive affect ([Simms et al., 2002](#)).

## 2. Method

### 2.1. Participants and procedure

We used archival data from Veterans Affairs Canada (VAC). VAC anonymously mailed self-administered questionnaires to 2760 Canadian veterans in 1999, with research ethics board approval. This target sample was randomly selected and nationally stratified from 18,443 individuals identified with health conditions after serving in the Canadian armed forces, receiving or eligible for a VAC disability pension (described in [Richardson et al., 2006](#)). Informed consent was implied based upon completion and return of the materials, with a response rate of 71.3% ( $n = 1968$ ).

Among those who returned the surveys, 1106 veterans served since 1990, of which 784 reported being deployed on at least one peacekeeping mission. We only report on these 784 respondents deployed since 1990, coinciding with an era of more stressful training and hazardous war-zone deployments (reviewed in [Sareen et al., 2010](#)).

Among the 784 respondents with valid data, 95.7% ( $n = 749$ ) were men. Age ranged from 20 to 65 years ( $M = 44.92$ ,  $SD = 9.67$ ). The majority completed high school/secondary education ( $n = 224$ , 29.8%), or had attended college ( $n = 199$ , 26.5%) or completed college education ( $n = 189$ , 25.1%). Canadian forces service duration ranged from <1 year to 45 years ( $M = 19.08$ ,  $SD = 10.42$ ). Concerning unique deployments, 54.1% ( $n = 424$ ) had been deployed once, 31.1% ( $n = 244$ ) were deployed twice, 11.1% ( $n = 87$ ) were deployed three times, and 2.3% ( $n = 18$ ) were deployed four or more times. Although race/ethnicity data are not typically collected in Canada, the vast majority of the larger veteran pool sampled was Caucasian.

### 2.2. Instrumentation

The PTSD Checklist (PCL)–military version was used to measure PTSD symptoms. The PCL ([Weathers et al., 1993](#)) is a 17-item self-report measure of PTSD severity, mirroring *DSM-IV*'s PTSD symptoms, using a five-point Likert scale (1 = “not at all” to 5 = “extremely”). The PCL has excellent internal consistency, test retest reliability, and diagnostic validity (reviewed in [McDonald and Calhoun, 2010](#)). The four-factor PTSD CFA model by [Simms et al. \(2002\)](#) has been supported with the PCL, including with military veterans (e.g., [Naifeh et al., 2010](#); [Pietrzak et al., 2010](#); [Simms et al., 2002](#)).

The CES-D ([Radloff, 1977](#)) is a 20-item, self-report depression instrument with a four-point Likert response format (0 = “rare or none of the time” to 3 = “most or all of the time”). Excellent internal consistency, test-retest reliability and convergent validity have been established ([Knight et al., 1997](#); [Radloff, 1977](#)). Several studies support a four-factor CES-D model (e.g., [Nguyen et al., 2004](#); [Sheehan et al., 1995](#)).

### 2.3. Analysis

Forty-four participants were eliminated for missing at least 20% of responses on the PCL or CES-D. Among the resulting sample of 740 subjects, 119 respondents on the PCL and 59 respondents on the CES-D were missing 1–2 items, distributed completely randomly; we used Mplus 6.1 software ([Muthén and Muthén, 2010a](#)) to derive parameter estimates using full information maximum likelihood (ML) procedures with a pairwise present estimation ([Muthén and Muthén, 2010b](#)).

Significant non-normality was found for the PCL. Therefore, ML estimation with a mean-adjusted Satorra–Bentler (S–B) chi-square statistic was used for the PCL CFA, which is robust to non-normality ([Satorra and Bentler, 2001](#)), treating PCL items as continuously-scaled. For CFAs including the CES-D items, we treated CES-D items as ordinal rather than continuous variables; as a result, those models used polychoric covariances and probit regression coefficients, robust weighted least squares estimation with a mean- and

variance-adjusted chi-square (WLSMV) (Flora and Curran, 2004; Wirth and Edwards, 2007).

We first conducted two CFAs – a four-factor PCL dysphoria model, and four-factor CES-D model, as specified above. We subsequently tested a joint, eight-factor, inter-correlated PCL/CES-D CFA. Residual error covariances were fixed to zero, and correlations between all latent factors were freely estimated.

In addition to chi-square values, robust versions of goodness of fit indices were examined, including the comparative fit index (CFI), Tucker–Lewis Index (TLI), root mean square error of approximation (RMSEA) (and for the PCL model, given its continuously-scaled nature, the standardized root mean square residual, or SRMR). Models that fit very well (or adequately) are indicated by CFI and TLI  $\geq .95$  (.90–.94), RMSEA  $< .06$  (to .08), and SRMR  $< .08$  (to .10) (Hu and Bentler, 1999). We also present Bayesian Information Criterion (BIC) values for comparing non-nested models with the same sets of variables; chi-square difference testing is not possible between models not nested within one another. BIC values are only computable using an ML estimator; therefore, since we used the WLSMV estimator, we re-computed analyses using ML estimation to derive BIC values. In comparing BIC values between models, a 10-point BIC difference represents a 150:1 likelihood and “very strong” ( $p < .05$ ) support that the model with the smaller BIC value fits best (Kass and Raftery, 1995).

Using the eight-factor PCL/CES-D CFA, we implemented validation analyses to test our hypotheses about the specific associations between PTSD's dysphoria factor and particular depression factors, relative to other PTSD factors. We tested these hypotheses by conducting individual Wald chi-square tests, testing the null hypothesis that the difference between two correlations would be zero (using an alpha level of .01).

### 3. Results

Total PCL scores averaged 30.95 ( $SD = 16.77$ ); a cutoff score of 50 in military veterans best discriminates between those with and without PTSD (McDonald and Calhoun, 2010). Total CES-D scores averaged 13.99 ( $SD = 12.31$ ); a score of 16 or higher indicates significant depression (Radloff, 1977). Internal consistency was excellent for the PCL ( $\alpha = .96$ ), and CES-D ( $\alpha = .93$ ).

A CFA for the four-factor dysphoria PTSD model fit the data very well,  $S-B \chi^2(113, N = 740) = 282.98, p < .001$ , CFI = .97, TLI = .96, RMSEA = .05 (90% CI: .039–.052),

SRMR = .03. A CFA for the four-factor CES-D model also fit well, robust  $\chi^2(164, N = 740) = 705.67, p < .001$ , CFI = .98, TLI = .97, RMSEA = .07 (90% CI: .062–.072).<sup>1,2</sup> The eight-factor combined model fit the data reasonably well, robust  $\chi^2(601, N = 740) = 1660.02, p < .001$ , CFI = .92, TLI = .91, RMSEA = .05 (90% CI: .046–.052). Table 1 displays factor intercorrelations.

Next we validated the factor structure by testing specific hypotheses about dysphoria's relationships with PTSD and depression factors. First, the CES-D's depressive affect factor was more related to PTSD's dysphoria ( $r = .77$ ) than to PTSD factors involving reexperiencing ( $r = .62$ , Wald  $\chi^2(1, N = 740) = 42.55, p < .001$ ), avoidance ( $r = .57$ , Wald  $\chi^2(1, N = 740) = 53.28, p < .001$ ), and hyperarousal ( $r = .67$ , Wald  $\chi^2(1, N = 740) = 20.01, p < .001$ ). Second, PTSD's dysphoria factor was more related to the CES-D's depressive affect factor ( $r = .77$ ) than to the positive affect factor ( $r = -.66$ , Wald  $\chi^2(1, N = 740) = 694.78, p < .001$ ) and interpersonal problems factor ( $r = .66$ , Wald  $\chi^2(1, N = 740) = 15.74, p < .001$ ); however, dysphoria was more related to somatic problems ( $r = .84$ , Wald  $\chi^2(1, N = 740) = 22.22, p < .001$ ) than to depressive affect.

Next, the CES-D's interpersonal problems factor was more related to PTSD's dysphoria ( $r = .65$ ) than to effortful avoidance ( $r = .49$ , Wald  $\chi^2(1, N = 740) = 27.54, p < .001$ ). Finally, the CES-D's somatic problems factor was more related to PTSD's dysphoria factor ( $r = .84$ ) than to reexperiencing ( $r = .66$ , Wald  $\chi^2(1, N = 740) = 68.83, p < .001$ ), avoidance ( $r = .60$ , Wald  $\chi^2(1, N = 740) = 76.36, p < .001$ ), and hyperarousal ( $r = .72$ , Wald  $\chi^2(1, N = 740) = 31.97, p < .001$ ).

### 4. Discussion

We found well-fitting models of PTSD and depression, using the PCL and CES-D, respectively, supporting previous factor analytic literature. When testing a combined eight-factor PTSD/depression model, this model fit fairly well. Validation analyses demonstrated that dysphoria was most closely related to the CES-D's depressive affect and somatic problems factors, suggesting that the shared variance between PTSD and depression may be due to dysphoric symptoms present in the PTSD diagnosis.

PTSD's dysphoria factor is a diverse construct that involves symptoms characterized by a numbing of general responsiveness and depressed mood (PTSD's C3–C7), but also involves an agitated or restless form of dysphoria that includes features of both anxiety and depression (D1–D3)

**Table 1**  
Correlations among PTSD and depression factors (N = 740).

	1	2	3	4	5	6	7	8
1. Reexperiencing	–							
2. Avoidance	.88	–						
3. Dysphoria	.83	.80	–					
4. Hyperarousal	.86	.77	.89	–				
5. Depressive affect	.62	.57	.77	.67	–			
6. Positive affect	–.40	–.38	–.45	–.37	–.66	–		
7. Somatic complaints	.66	.60	.84	.72	.93	–.54	–	
8. Interpersonal problems	.50	.49	.65	.60	.79	–.51	.74	–

<sup>1</sup> We were concerned that perhaps if the positive affect factor's items were reverse-coded, it would be redundant with the depressive affect factor. We therefore reverse-coded positive affect factor items, and using a chi-square difference test (Muthén and Muthén, 2010b), a three-factor CES-D model ( $BIC = 24,085.71$ ) that merged these affect factors resulted in a significantly worse fit than the four-factor model ( $BIC = 23,624.01$ ),  $\chi^2_{diff}(3, N = 740) = 294.30, p < .001$ . Thus these factors did not appear redundant, supporting previous research (Sheehan et al., 1995).

<sup>2</sup> Because we found a large correlation between depressive affect and somatic complaints ( $r = .93$ ), we tested whether a three-factor model that merged these two factors resulted in a significantly worse fit than the four-factor model. The three-factor model had a worse fit ( $BIC = 23,943.74$ ) than the four-factor model ( $BIC = 23,624.01$ ),  $\chi^2_{diff}(3, N = 740) = 87.82, p < .001$ , suggesting that these factors are distinct, supporting previous research (Nguyen et al., 2004).

(Elhai et al., 2011). Thus it is not too surprising that dysphoria was more related to somatic problems than to depressed affect, given overlap between PTSD's D1–D3 symptoms with the CES-D's somatic complaints that too involve a similar construct.

Results are generalizable primarily to the CES-D and PCL, but suggest that there are non-specific dimensions of PTSD (i.e., dysphoria) that are substantially related to dimensions of depression. These findings provide more support for some authors' contention that PTSD has diminished construct validity (Rosen and Lilienfeld, 2008; Spitzer et al., 2007).

Several limitations apply to the present study. First, we only sampled military veterans, and thus generalizability to civilian victims of psychological trauma is not known. Furthermore, the sample was not representative of military veterans in general, given their Canadian nationality, and selection based on experiencing a health-related disability. Additionally, our lack of structured diagnostic interviews limits generalizability to individuals assessed with self-report instruments.

Nonetheless, despite these limitations, the present study adds to previous literature by providing a better understanding of dysphoria's relation to depressive affect and somatic depression. Given that dysphoria is a diverse construct within PTSD, future research should further test whether dysphoria has unique components that are differentially related to external measures of distress.

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#### Conflict of interest

The authors have no perceived or actual conflicts of interest related to this project. However, Dr. Richardson is a paid consultant for VA Canada.

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#### References

- Adkins, J.W., Weathers, F.W., McDevitt-Murphy, M.E., Daniels, J.B., 2008. Psychometric properties of seven self-report measures of posttraumatic stress disorder in college students with mixed civilian trauma exposure. *J. Anxiety Disord* 22, 1393–1402.
- Elhai, J.D., Palmieri, P.A., 2011. The factor structure of posttraumatic stress disorder: A literature update, critique of methodology, and agenda for future research. *J. Anxiety Disord* 25, 849–854.
- Elhai, J.D., Grubaugh, A.L., Kashdan, T.B., Frueh, B.C., 2008. Empirical examination of a proposed refinement to DSM-IV posttraumatic stress disorder symptom criteria using the National Comorbidity Survey Replication data. *J. Clin. Psychiatry* 69, 597–602.
- Elhai, J.D., Biehn, T.L., Armour, C., Klopper, J.J., Frueh, B.C., Palmieri, P.A., 2011. Evidence for a unique PTSD construct represented by PTSD's D1–D3 symptoms. *J. Anxiety Disord* 25, 340–345.
- Elklit, A., Armour, C., Shevlin, M., 2010. Testing alternative factor models of PTSD and the robustness of the dysphoria factor. *J. Anxiety Disord* 24, 147–154.
- Flora, D.B., Curran, P.J., 2004. An empirical evaluation of alternative methods of estimation for confirmatory factor analysis with ordinal data. *Psychol Methods* 9, 466–491.
- Forbes, D., Parslow, R., Creamer, M., O'Donnell, M., Bryant, R., McFarlane, A., Silove, D., Shalev, A., 2010. A longitudinal analysis of posttraumatic stress disorder symptoms and their relationship with fear and anxious-misery disorders: implications for DSM-V. *J. Affect. Disord* 127, 147–152.
- Grubaugh, A.L., Long, M.E., Elhai, J.D., Frueh, B.C., Magruder, K.M., 2010. An examination of the construct validity of posttraumatic stress disorder with veterans using a revised criterion set. *Behav. Res. Ther* 48, 909–914.
- Hu, L., Bentler, P.M., 1999. Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. *Structural Equation Modeling* 6, 1–55.
- Kass, R.E., Raftery, A.E., 1995. Bayes factors. *J. Am Stat Assoc* 90, 773–795.
- Kessler, R.C., Sonnega, A., Bromet, E., Hughes, M., Nelson, C.B., 1995. Posttraumatic stress disorder in the National Comorbidity Survey. *Arch. Gen. Psychiatry* 52, 1048–1060.
- King, D.W., Leskin, G.A., King, L.A., Weathers, F.W., 1998. Confirmatory factor analysis of the Clinician-Administered PTSD Scale: evidence for the dimensionality of posttraumatic stress disorder. *Psychol Assess* 10, 90–96.
- Knight, R.G., Williams, S., McGee, R., Olaman, S., 1997. Psychometric properties of the Centre for Epidemiologic Studies Depression Scale (CES-D) in a sample of women in middle life. *Behav. Res. Ther* 35, 373–380.
- Marshall, G.N., Schell, T.L., Miles, J.N.V., 2010. All PTSD symptoms are highly associated with general distress: ramifications for the dysphoria symptom cluster. *J. Abnorm. Psychol* 119, 126–135.
- McDonald, S.D., Calhoun, P.S., 2010. The diagnostic accuracy of the PTSD Checklist: a critical review. *Clin. Psychol. Rev* 30, 976–987.
- Miller, M.W., Wolf, E.J., Harrington, K.M., Brown, T.A., Kaloupek, D.G., Keane, T.M., 2010. An evaluation of competing models for the structure of PTSD symptoms using external measures of comorbidity. *J. Trauma. Stress* 23, 631–638.
- Muthén, B.O., Muthén, L.K., 2010a. Mplus. Los Angeles, California.
- Muthén, B.O., Muthén, L.K., 2010b. Technical Appendices. Los Angeles, California.
- Naifeh, J.A., Richardson, J.D., Del Ben, K.S., Elhai, J.D., 2010. Heterogeneity in the latent structure of PTSD symptoms among Canadian veterans. *Psychol Assess* 22, 666–674.
- Nguyen, H.A., Kitner-Triolo, M., Evans, M.K., Zonderman, A.B., 2004. Factorial invariance of the CES-D in low socioeconomic status African Americans compared with a nationally representative sample. *Psychiatry Res* 126, 177–187.
- Pietrzak, R.H., Goldstein, M.B., Malley, J.C., Rivers, A.J., Southwick, S.M., 2010. Structure of posttraumatic stress disorder symptoms and psychosocial functioning in Veterans of Operations Enduring Freedom and Iraqi Freedom. *Psychiatry Res* 178, 323–329.
- Radloff, L.S., 1977. The CES-D Scale: a self-report depression scale for research in the general population. *Applied Psychological Measurement* 1, 385–401.
- Richardson, J.D., Elhai, J.D., Pedlar, D., 2006. Association of PTSD and depression with medical and specialist care utilization in modern peacekeeping veterans in Canada with health-related disabilities. *J. Clin. Psychiatry* 67, 1240–1245.
- Rosen, G.M., Lilienfeld, S.O., 2008. Posttraumatic stress disorder: an empirical evaluation of core assumptions. *Clin. Psychol. Rev* 28, 837–868.
- Sareen, J., Stein, M.B., Thoresen, S., Belik, S.-L., Zamorski, M., Asmundson, G.J.G., 2010. Is peacekeeping peaceful? A systematic review. *Can J Psychiatry* 55, 464–472.
- Satorra, A., Bentler, P.M., 2001. A scaled difference chi-square test statistic for moment structure analysis. *Psychometrika* 66, 507–514.
- Sheehan, T.J., Fifeield, J., Reisine, S., Tennen, H., 1995. The measurement structure of the Center for Epidemiologic Studies Depression Scale. *J. Pers. Assess* 64, 507–521.
- Simms, L.J., Watson, D., Doebbeling, B.N., 2002. Confirmatory factor analyses of posttraumatic stress symptoms in deployed and nondeployed veterans of the Gulf War. *J. Abnorm. Psychol* 111, 637–647.
- Spitzer, R.L., First, M.B., Wakefield, J.C., 2007. Saving PTSD from itself in DSM-V. *J. Anxiety Disord* 21, 233–241.
- Weathers, F.W., Litz, B.T., Herman, D.S., Huska, J.A., Keane, T.M., 1993. The PTSD Checklist: Reliability, Validity, & Diagnostic Utility. Annual Meeting of the International Society for Traumatic Stress Studies, San Antonio, Texas.
- Weathers, F.W., Keane, T.M., Davidson, J.R., 2001. Clinician-administered PTSD scale: a review of the first ten years of research. *Depress. Anxiety* 13, 132–156.
- Wirth, R.J., Edwards, M.C., 2007. Item factor analysis: current approaches and future directions. *Psychol Methods* 12, 58–79.
- Yufik, T., Simms, L.J., 2010. A meta-analytic investigation of the structure of posttraumatic stress disorder symptoms. *J. Abnorm. Psychol* 119, 764–776.