

Research Article

TESTING THE DIMENSIONALITY OF POSTTRAUMATIC STRESS RESPONSES IN YOUNG CHINESE ADULT EARTHQUAKE SURVIVORS: FURTHER EVIDENCE FOR “DYSPHORIC AROUSAL” AS A UNIQUE PTSD CONSTRUCT

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Background: *This study investigated an alternative five-factor diagnostic model for posttraumatic stress disorder (PTSD) symptoms, and tested external convergent and discriminant validity of the model in a young Chinese sample of earthquake survivors. Methods:* *A total of 938 participants (456 women, 482 men) aged 15–20 years were recruited from a vocational school originally located in Beichuan County Town which was almost completely destroyed by the “Wenchuan Earthquake.” The participants were administered with the PTSD Checklist and the Hopkins Symptoms Checklist-25 12 months after the earthquake. Results:* *The results of confirmatory factor analysis showed that the five-factor intercorrelated model (intrusion, avoidance, numbing, dysphoric arousal, and anxious arousal) fit the data significantly better than the four-factor numbing model proposed by King et al. (1998: Psychol Assess 10:90–96) and the four-factor dysphoria model proposed by Simms et al. (2002: J Abnorm Psychol 111:637–647). Further analyses indicated that four out of five PTSD factors yielded significantly different correlations with external measures of anxiety versus depression. Conclusions:* *The findings provide further empirical evidence in favor of the five-factor diagnostic model of PTSD, and carry implications for the upcoming DSM-5. Depression and Anxiety 0:1–8, 2011.* © 2011 Wiley-Liss, Inc.

Key words: *posttraumatic stress disorder; confirmatory factor analysis; external validity; earthquake; China*

INTRODUCTION

According to the current revision of the Diagnostic and Statistical Manual of Mental Disorders [DSM-IV-TR],^[1] posttraumatic stress disorder (PTSD) is an anxiety disorder that can result from exposure to extraordinarily stressful events, and consists of 17

The authors disclose the following financial relationships within the past 3 years: Contract grant sponsor: National Natural Science Foundation of China; Contract grant number: 30900402; Contract grant sponsor: China Postdoctoral Science Fund; Contract grant number: 200902143; Contract grant sponsor: Knowledge Innovation Project of the Chinese Academy of Sciences; Contract grant number: KSCX2-EW-Q-18.

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Received for publication 18 January 2011; Revised 23 March 2011; Accepted 29 March 2011

DOI 10.1002/da.20823

Published online in Wiley Online Library (wileyonlinelibrary.com).

symptoms associated with posttraumatic stress reactions. Mainly based on expert consensus, these symptoms are categorized into three clusters: intrusion (Criterion B), effortful avoidance and emotional numbing (Criterion C), and hyperarousal (Criterion D). However, with a few exceptions,^[2,3] most factor analytic studies have found that this tripartite diagnostic model does not accurately capture the latent structure of PTSD symptoms, and several alternative models have been proposed.^[4-9] In recent years, increasing empirical evidence has converged on two four-factor models.^[10,11] However, neither of the four-factor models seems to fit best across research studies, and newer conceptualizations that further refine the four factors have been recently developed and tested with empirical support.^[12]

The first four-factor model of PTSD was proposed and supported by King et al.^[4] namely the four-factor numbing model. This model generally follows the DSM-IV organization, except that symptoms of avoidance and numbing (Criterion C) are split into two separate factors. The modification results in a model composed of intrusion, avoidance, numbing, and hyperarousal factors. The model reflects a growing body of findings indicating that avoidance and numbing have different relations with treatment course and outcome,^[13,14] and are differentially related to external psychological and behavioral variables.^[15-17] Another alternative four-factor PTSD model was developed and supported by Simms et al.^[7] namely the four-factor dysphoria model. In this revision of the King et al. model, three hyperarousal symptoms (i.e., sleep difficulty, irritability, and concentration problems) are combined with the numbing symptoms to form a dysphoria factor (reflecting general negative affectivity which is shared with several mood and anxiety disorders). Therefore, the final model of Simms et al. comprises intrusion, avoidance, dysphoria, and two-item hyperarousal factor. This model has the theoretical advantage in differentiating specific and nonspecific constructs underlying PTSD symptoms, and may help to explain the high comorbidity of PTSD and several mood and anxiety disorders.

Both the four-factor models have received extensive empirical support in confirmatory factor analytic (CFA) studies with samples exposed to various traumatic events.^[10,11,18] Among studies directly comparing the two models, mixed results have been found. Some studies found support for the numbing model of King et al.^[16,19-25] whereas others found support for the dyphoria model of Simms et al.^[26-32] Recently, Yufik and Simms conducted a meta-analysis of 40 previous PTSD studies, and found that although the four-factor models both yielded good model fit across subsamples of studies, the dyphoria model appeared to provide a superior fit to the numbing model across studies.^[11] However, the authors also highlighted that given that their sampling of relevant studies was not exhaustive, firm conclusions on the relative merits of the models were not possible based on the results.

The four-factor numbing model and four-factor dyphoria model only differ in placement of three PTSD symptoms: sleep difficulty (D1), irritability (D2), and concentration problems (D3). Building upon previous theoretical and empirical studies suggesting that these three symptoms may be psychopathologically unique,^[33-35] Elhai et al. argued that D1-D3 symptoms differ conceptually from both PTSD's anxious arousal construct (i.e., hypervigilance and exaggerated startle response) and PTSD's depression/dysphoric construct (i.e., emotional numbing), although these symptoms are both somewhat anxiety-related and depression-related.^[12] Elhai et al. reconceptualized the three symptoms as a separate dysphoric arousal factor, and proposed a five-factor PTSD model composed of intrusion, avoidance, numbing, dysphoric arousal, and anxious arousal factors. By analyzing data from 252 women victims of domestic violence, Elhai et al. found that the five-factor model fit the data significantly better than the four-factor models.^[12] In a subsequent CFA study, Wang et al. further tested the five-factor model in two large Chinese samples varying in type of trauma exposure (an earthquake versus a violent riot), demographics, symptom severity, and elapsed time since trauma exposure.^[36] The results indicated that the five-factor model fit significantly better than the four-factor models across samples. The findings provide further empirical support for the five-factor PTSD model.

Despite the promising findings, compared with the well-supported four-factor models, the newly developed five-factor PTSD model has only been supported by limited empirical studies. Additional research testing the model is clearly needed. Moreover, as suggested by several researchers,^[37] a diagnostic model cannot be validated using internal fit statistics alone. Studies examining external convergent and discriminant validity of the model are also needed. In this study, we first investigated the five-factor model in a Chinese sample of earthquake victims recruited from a vocational school originally located in Beichuan County Town which was almost completely destroyed by the "Wenchuan Earthquake." Subsequently, we further examined relationships between PTSD symptom factors and external measures of anxiety and depression. As suggested by previous theoretical and empirical studies,^[12,33-36] the intrusion, avoidance, and anxious arousal factors are anxiety-related PTSD constructs, the numbing factor is a depression-related PTSD construct, and the dysphoric arousal factor is a both anxiety-related and depression-related PTSD construct. Therefore, we hypothesized that: (1) the five-factor model would fit data significantly better than both the four-factor models; (2) the intrusion, avoidance, and anxious arousal factors would be more associated with external measure of anxiety than depression, the numbing factor would be more associated with depression than anxiety, and the dysphoric arousal factor would be associated with anxiety and depression equally.

METHODS

PARTICIPANTS

On May 12, 2008, southwest China was struck by a deadly earthquake that measured 8.0 on the Richter scale. During the earthquake, 69,227 people were killed, 374,643 injured, 17,923 listed as missing, and about 4.8 million left homeless. For the purpose of assessing disaster-related mental health needs, and implementing effective psychological assistance and interventions in the earthquake-affected area, the sample was collected by a psychological relief workstation established by the Institute of Psychology, Chinese Academy of Sciences in Beichuan County. During the earthquake, the Beichuan County Town was almost completely destroyed, and more than 6,000 people (approximately 60% of the population) were killed.

This study's sample consisted of 938 students who came from a vocational school originally located in Beichuan County Town. There was no overlap between this sample and the community sample we used in a previous study.^[36]

Among participants, 482 (51.4%) were male, and 456 (48.6%) were female. Age ranged from 15 to 20 years ($M = 16.2$, $SD = 0.9$). Two hundred and forty-six (26.2%) were of Han ethnicity, 670 (71.4%) were Qiang, and 22 (2.3%) were Tibetan. All participants personally experienced this life-threatening earthquake and thus met criteria for PTSD's Criterion A1 traumatic stressor criterion.

MEASURES

The PTSD Checklist—Specific Stressor Version (PCL-S)^[38] was used to assess PTSD symptoms. The PCL is a 17-item self-report scale based on DSM-IV criteria, and each item is rated on a 5-point Likert scale reflecting severity of PTSD symptoms from 1 (*not at all*) to 5 (*extremely*) during the past month. The English version of the PCL has been demonstrated to have sound psychometric properties in a variety of trauma-exposed populations.^[39,40] The Chinese version of the PCL was translated with a two-stage process of translation and back translation.^[41] Adequate levels of internal consistency (Cronbach's α above .77) for the total scale have been previously reported.^[25,41,42] The test-retest reliability (3-week interval) was .84 for the total scale.^[41] Associations with other PTSD measures including the Impact of Event Scale-Revised,^[43] the Clinician-Administered Posttraumatic Stress Disorder Scale,^[44] and the General Health Questionnaire-20^[45] have demonstrated convergent and discriminant validity of the Chinese PCL.^[41] Although the PCL was primarily validated in adults (age 18 and over), its applicability in adolescents is also supported by previous studies with Western and Chinese samples.^[25,46–48] In this study, the PCL items were completed with respect to the “Wenchuan Earthquake.” Cronbach's α for the scale was .91 in current sample.

The Hopkins Symptoms Checklist-25 (HSCL-25)^[49] was used to assess anxiety and depression symptoms. The HSCL-25 comprises a 10-item subscale for anxiety and a 15-item subscale for depression. Each item is rated on a 4-point Likert scale ranging from 1 (*not at all*) to 4 (*extremely*), reflecting the extent to which the particular symptom is a problem for the respondent during the past month. Reliability and validity of the scale have been well-documented in studies with samples from various cultural contexts.^[49–52] Most items of the HSCL-25 are derived from the Symptom Checklist-90 (SCL-90)^[53] which has been validated and widely used in China.^[54,55] Based on the English and Chinese versions of the SCL-90, the Chinese version of the HSCL-25 was adapted with a two-stage process of translation and back translation by two Chinese clinical psychologists who are fluent in both Chinese and English. In the current sample, Cronbach's α was .89 for the anxiety subscale, and .91 for the depression subscale.

PROCEDURE

The data were collected 12 months after the “Wenchuan Earthquake.” The investigators included trained clinical psychologists, psychiatrists, and psychotherapists. All students present at the school took part in the survey. Participants completed the measures in a group administration format in their classrooms. Before administering self-reported questionnaires to the participants, investigators obtained oral informed consent and introduced the aim and significance of the survey in detail. The procedure was approved by the ethics committee of the Institute of Psychology, Chinese Academy of Sciences.

DATA ANALYSIS

All descriptive analyses were conducted using the Statistical Package for the Social Sciences version 11.5 for Windows. Of participants, there were 20 (2.1%) missing 1 or 2 PCL items, 14 (1.5%) missing 1 or 2 anxiety items, and 18 (1.9%) missing 1 or 2 depression items. As suggested by Schafer and Graham,^[56] these missing values were estimated with full information maximum likelihood (ML) procedures using all available scale data.

Three alternative PTSD models were examined in this study (see Table 1 for item mappings), including the four-factor numbing model of King et al. (Model 1), the four-factor dysphoria model of Simms et al. (Model 2), and the five-factor model of Elhai et al. (Model 3). The CFA was conducted to evaluate the models using Lisrel 8.72.^[57] As the preliminary normality test indicated that the data were not multivariate normal, $\chi^2(2, N = 938) = 4882.38$, $P < .001$, ML estimation was implemented using the mean-adjusted, scaled Satorra–Bentler chi-square statistic (S-B χ^2)^[58] to correct for non-normality. In all of the models estimated, error covariances were fixed to zero, and factors were permitted to correlate. We used four indices to evaluate goodness-of-fit for the models, including the root-mean square error of approximation (RMSEA), the standardized root mean square residual (SRMR), the comparative fit index (CFI), and the Tucker–Lewis index (TLI). As recommended by Hu and Bentler,^[59,60] excellent fit is indicated by CFI and TLI $\geq .95$, RMSEA $\leq .06$, and SRMR $\leq .08$. We used the corrected scaled χ^2

TABLE 1. Item mapping for confirmatory factor analysis

PTSD symptoms	Model 1	Model 2	Model 3
B1. Intrusive thoughts	I	I	I
B2. Nightmares	I	I	I
B3. Flashbacks	I	I	I
B4. Emotional reactivity	I	I	I
B5. Physical reactivity	I	I	I
C1. Avoidance of thoughts	A	A	A
C2. Avoidance of reminders	A	A	A
C3. Amnesia for aspects	N	D	N
C4. Loss of interest	N	D	N
C5. Feeling distant	N	D	N
C6. Feeling numb	N	D	N
C7. Foreshortened future	N	D	N
D1. Sleep disturbance	H	D	DA
D2. Irritability	H	D	DA
D3. Difficulty concentrating	H	D	DA
D4. Hypervigilance	H	H	AA
D5. Exaggerated startle	H	H	AA

Note: I = Intrusion; A = Avoidance; N = Numbing; H = Hyperarousal; D = Dysphoria; DA = Dysphoric arousal; AA = Anxious arousal.

difference test^[61] to compare nested models (i.e., Model 3 versus Models 1 and 2), and used the Bayesian information criterion (BIC)^[62] to compare nonnested models (i.e., Model 1 versus Model 2). As suggested by Raftery,^[63] a BIC difference of 6–10 indicates strong support, and a difference greater than 10 indicates very strong support, for the model with lower BIC value. The BIC is not included in LISREL 8.72 output, and was thus calculated separately using the following formula: $BIC = S - B\chi^2 + \ln(N) * t$, where N = sample size and t = number of parameters estimated in the model.^[63]

After testing three PTSD models discussed above, we subsequently used the five-factor PTSD model and built two additional factors within a larger CFA, by adding a latent anxiety factor represented by 10 items of the HSCL anxiety subscale, and a latent depression factor represented by 15 items of the HSCL depression subscale (Fig. 1). Following above-mentioned procedure and methods used to test the PTSD models, we submitted this seven-factor model to CFA to calculate correlation coefficients between the PTSD factors and the anxiety and depression factors. Fisher’s z -tests were computed to compare the strength of correlations between the five PTSD factors and each of the anxiety and depression factors. All P values reported for the z statistics are two-tailed.

RESULTS

DESCRIPTIVE STATISTICS

The mean score on the PCL was 32.7 ($SD = 10.0$, range: 17–73) for the current sample. As suggested by previous studies using civilian trauma victim samples in United States^[39] and using earthquake survivor samples in China,^[64,65] a “probable PTSD case” was identified by using a cutoff score of 44 on the PCL. Based on the criterion, 125 (13.3%) participants were identified as probable PTSD cases. Regarding the severity of anxiety and depression symptoms, mean scores on the HSCL anxiety and depression subscales were 15.3 ($SD = 4.7$, range: 10–34), and 24.2 ($SD = 7.6$, range: 15–55), respectively.

FACTOR STRUCTURE OF PTSD SYMPTOMS

Table 2 presents fit statistics for the three competing models. According to the above-mentioned criteria, all

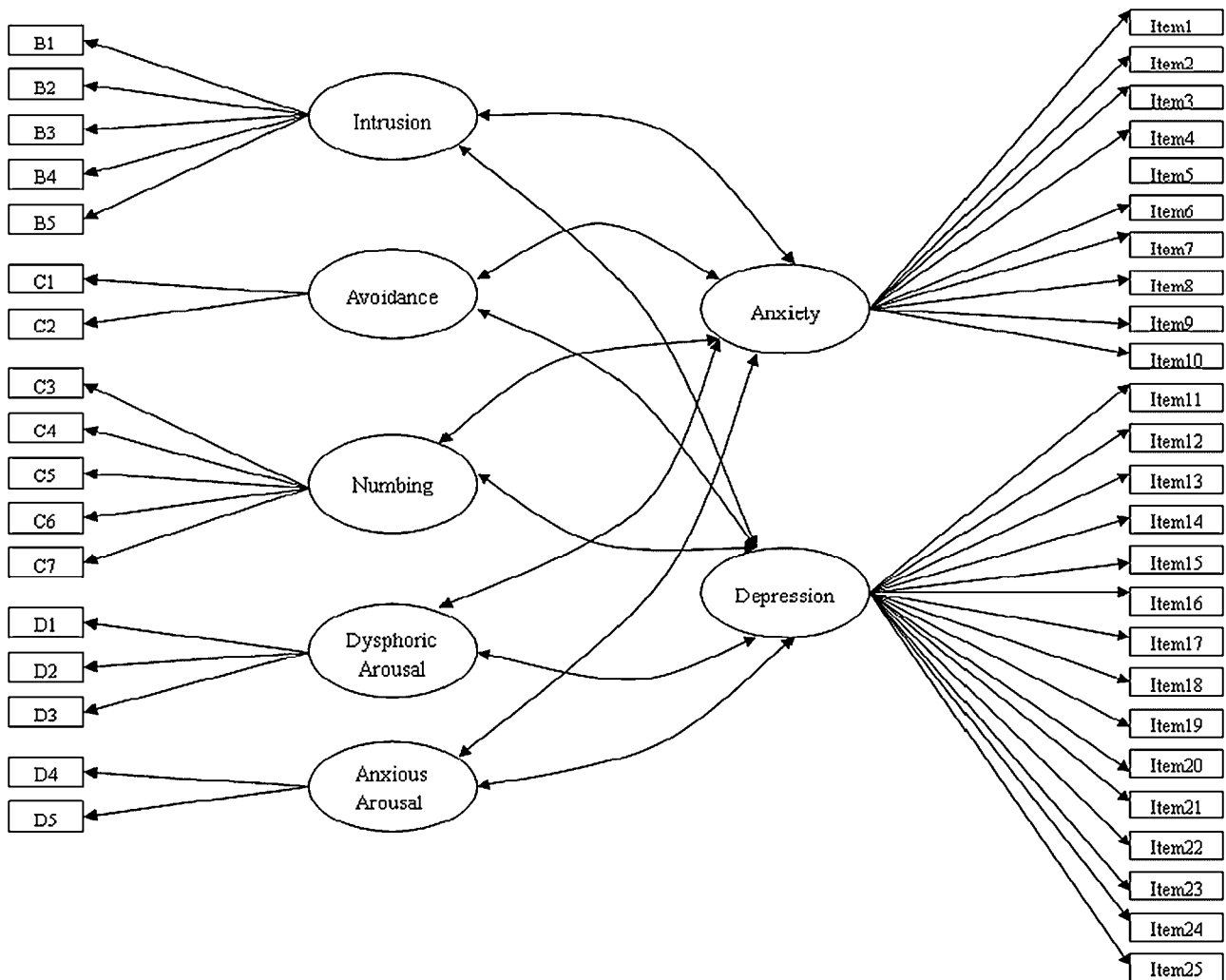


Figure 1. Structure of the model comprising seven intercorrelated factors: five PTSD factors, one anxiety factor, and one depression factor.

TABLE 2. Model goodness of fit indices

Models	χ^2	S-B χ^2	df	CFI	TLI	SRMR	RMSEA	RMSEA 90% CI	BIC
Model 1	583.28	388.40	113	.985	.982	.045	.051	.046–.057	662.15
Model 2	646.60	428.86	113	.983	.979	.045	.055	.049–.060	702.61
Model 3	504.28	338.19	109	.987	.984	.044	.047	.042–.053	639.31

Note: S-B χ^2 = scaled Satorra-Bentler χ^2 ; CFI = Comparative fit index; TLI = Tucker-Lewis index; SRMR = Standardized root mean square residual; RMSEA = Root mean square error of approximation; CI = Confidence interval; BIC = Bayesian information criterion.

TABLE 3. Standardized factor loadings and factor correlations for the five-factor PTSD model

	I	A	N	DA	AA
B1. Intrusive thoughts	.69				
B2. Nightmares	.67				
B3. Flashbacks	.72				
B4. Emotional reactivity	.75				
B5. Physical reactivity	.71				
C1. Avoidance of thoughts		.74			
C2. Avoidance of reminders		.81			
C3. Amnesia for aspects			.53		
C4. Loss of interest			.68		
C5. Feeling distant			.69		
C6. Feeling numb			.56		
C7. Foreshortened future			.58		
D1. Sleep disturbance				.73	
D2. Irritability				.73	
D3. Difficulty concentrating				.75	
D4. Hypervigilance					.73
D5. Exaggerated startle					.79
Factor correlations					
A	.73				
N	.63	.63			
DA	.69	.59	.79		
AA	.76	.65	.76	.85	

Note: N = 938. I = Intrusion; A = Avoidance; N = Numbing; DA = Dysphoric arousal; AA = Anxious arousal.

models achieved excellent fit. Based on BIC values (for non-nested models comparison), Model 1 (the four-factor numbing model) fit better than Model 2 (the four-factor dysphoria model), indicated by a Δ BIC of -40.46 . The results of the corrected scaled χ^2 difference tests (for nested model comparisons) showed that Model 3 (the five-factor model) fit significantly better than both Model 1 (Δ S-B χ^2 (4, N = 938) = 44.11, $P < .001$) and Model 2 (Δ S-B χ^2 (4, N = 938) = 72.62, $P < .001$). Therefore, Model 3 emerged as the best fitting model in the current sample. The standardized factor loadings and factor correlations of Model 3 can be found in Table 3.

RELATIONSHIPS WITH EXTERNAL MEASURES OF ANXIETY AND DEPRESSION

The seven-factor model also achieved excellent fit. Fit statistics for the model were: $\chi^2(798, N = 938) = 3094.60$, S-B $\chi^2 = 2060.92$, CFI = .988, TLI = .987,

TABLE 4. Comparison of the strength of correlations between the five PTSD factors and each of the anxiety and depression factors

Factors	Anxiety	Depression	Z	P
Intrusion	.74	.54	7.49	<.001
Avoidance	.60	.50	3.11	.002
Numbing	.72	.82	-5.39	<.001
Dysphoric arousal	.75	.78	-1.57	.117
Anxious arousal	.84	.69	8.07	<.001

Note: N = 938. The correlation coefficient between the anxiety and depression factors was .76.

SRMR = .048, RMSEA = .041 (90% CI: .039–.043), and BIC = 2779.51. Correlation coefficients between the five PTSD factors and each of the anxiety and depression factors are presented in Table 4. The results of Fisher’s z-tests indicated that all but one of PTSD’s five factors displayed significantly different correlations with the anxiety versus depression factors (also see Table 4). The intrusion, avoidance and anxious arousal factors demonstrated significantly higher correlations with the anxiety factor than with the depression factor. In contrast, the numbing factor showed significantly higher correlations with the depression factor than with the anxiety factor. Finally, the dysphoric arousal factor associated with the anxiety and depression factors equally.

DISCUSSION

This study tested the dimensionality of PTSD symptoms in a young Chinese sample of earthquake victims. The major findings included that: (1) a five-factor intercorrelated model (intrusion, avoidance, numbing, dysphoric arousal, and anxious arousal) provided a superior fit to the two well-supported four-factor models proposed by King et al. and Simms et al., respectively; (2) for all but the dysphoric arousal factor, PTSD’s factors displayed significantly different correlations with external measures of anxiety versus depression. The findings support the proposition that the dysphoric arousal represented by PTSD’s D1-D3 symptoms represents a unique PTSD construct, and increase our understanding of the structure of PTSD symptoms.

With the expected advent of the DSM-5, examining the factor structure of PTSD symptoms has been a topic of great interest in the field of traumatic stress. In recent years, increasing empirical evidences have converged on the four-factor numbing model proposed by King et al. and the four-factor dysphoria model proposed by Simms et al.^[10,11] The models only differ in placement of PTSD's D1-D3 symptoms. In this study, we investigated an alternative five-factor model in which these three symptoms were treated as a separate factor. Generally congruent with previous reports,^[12,36] this study found that the five-factor model fit the data significantly better than the well-supported four-factor models. The findings suggest that posttraumatic stress responses can be best explained by intrusion, avoidance, numbing, dysphoric arousal, and anxious arousal symptom clusters. Given that we used a sample consisting of adolescents and young adults while the previous studies used adult samples, this replication supports but extends previous findings for the five-factor model.

To extend extant empirical evidence for the five-factor PTSD model, we further examined relationships between the five PTSD factors and external measures of anxiety and depression. Based on previous theoretical and empirical work,^[12,34,35] we hypothesized that the five PTSD factors would differentially correlate with the anxiety versus depression constructs. Specifically, the anxiety-related PTSD constructs (i.e., intrusion, avoidance, and anxious arousal) would be more associated with anxiety than depression; the depression-related PTSD construct (i.e., numbing) would be more associated with depression than anxiety; and as a both anxiety-related and depression-related PTSD construct, the dysphoric arousal factor would be associated with anxiety and depression equally. The results confirmed our hypotheses, and provided support for external convergent and discriminant validity of the five-factor PTSD model recently proposed by Elhai et al.^[12]

It should be noted that according to some researchers,^[66] PTSD's D1-D3 symptoms which we call "dysphoric arousal" may not indeed belong to PTSD at all. As commented by Spitzer et al.^[66] these three symptoms as well as C3-C4 symptoms (amnesia for aspects and loss of interest) are symptoms of general distress or general response to negative events, and are shared with other psychiatric disorders (e.g., Major Depressive Disorders and Generalized Anxiety Disorder). Therefore, Spitzer et al. proposed removing these symptoms from the diagnostic criteria entirely for their lack of specificity to PTSD. However, this proposition has been challenged by several empirical studies. Marshall et al. examined associations between individual PTSD symptoms and general distress, and found that these five nonspecific symptoms are not more strongly associated with external measures of general distress than other PTSD symptoms.^[67] Furthermore, some researchers also have found that removing these symptoms from the

PTSD diagnosis does not seem to have big changes on the prevalence and comorbidity of PTSD.^[68-70] Taken together, it would not be wise to removing these symptoms from the PTSD diagnosis, although the exact role of them within the diagnosis is less clear at this time.

Understanding the latent dimensions of PTSD symptoms is vitally important in organizing clinically useful diagnostic criteria that can guide effective assessment and intervention. Based on the well-supported distinction of avoidance and numbing symptoms, the draft criteria for PTSD listed in the proposed revision of the DSM has been reorganized into four (rather than three) symptom clusters.^[71] The findings of this study implicate that a further distinction of the dysphoric arousal and anxious arousal symptoms may deserve special consideration in reorganizing DSM-5's PTSD criteria. Furthermore, as reported in previous studies, the hyperarousal factor represented by PTSD's D1-D5 symptoms listed in the DSM-IV may play prominent role in the natural course of posttraumatic distress following trauma exposure,^[72,73] and may be more closely associated with functional impairment than other PTSD factors.^[22,74] Further specifying the differentiated role of dysphoric arousal and anxious arousal in the development of posttraumatic symptomatology may advance our understanding of the pathogenesis and nature of PTSD, and inform the targeting of special symptoms for prevention and treatment programs.

Several limitations to this study should be noted. First, to the best of our knowledge, this study is the first one to examine external convergent and discriminant validity of the five-factor PTSD model. Additional studies to test the findings are clearly needed. Second, our findings also were limited by relying on self-reported measures. Thus, the findings need to be subjected to further testing using data from clinician-rated measures. Third, in this study, we only adopted a few external psychopathological variables to test convergent and discriminant validity of the five-factor PTSD model. Future studies should further examine differentiable correlations between the five PTSD factors with a range of external psychological, biological, and behavioral variables.

Despite these limitations, this study is one of a few studies that investigated the newly proposed five-factor PTSD model, and is the first study that examined external psychopathological correlates of the model. Our findings provide further empirical evidence in favor of the five-dimensional reconceptualization of PTSD symptoms recently proposed by Elhai et al.^[12] and add to extant knowledge about the structure of PTSD symptoms. Considering the impending DSM-5, the information provided by this study is useful for reconsidering organizing new PTSD criteria.

Acknowledgments. This study was supported by National Natural Science Foundation of China (No. 30900402), China Postdoctoral Science Found

(No. 200902143), and the Knowledge Innovation Project of the Chinese Academy of Sciences (No. KSCX2-EW-Q-18). The funders had no role in study design, data collection and analysis, decision to publish, and preparation of the manuscript.

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