Behaviour Research and Therapy 47 (2009) 487–493

Contents lists available at ScienceDirect

Behaviour Research and Therapy

journal homepage: www.elsevier.com/locate/brat

Specificity of autonomic arousal to DSM-IV panic disorder and posttraumatic stress disorder

Timothy A. Brown*, Judiann McNiff

Center for Anxiety & Related Disorders, Department of Psychology, Boston University, 648 Beacon Street, 6th floor, Boston, MA 02215-2013, USA

ARTICLE INFO

Article history:
Received 20 October 2008
Received in revised form
11 February 2009
Accepted 23 February 2009

Keywords:
Panic disorder
Posttraumatic stress disorder
Autonomic arousal
Diagnostic classification

ABSTRACT

Although research on the hierarchical model of anxiety and depression has confirmed that autonomic arousability (AA) is more germane to panic disorder with or without agoraphobia (PD/A) than other DSM-IV anxiety and mood disorders, studies have not evaluated the differential relevance of AA to posttraumatic stress disorder (PTSD). This issue was addressed in multivariate analytic models using 295 outpatients with anxiety and mood disorders. Consistent with prediction, the presence of current DSM-IV PTSD and PD/A was significantly predictive of AA, even when other forms of anxiety disorder comorbidity were held constant. Moreover, latent structural analyses indicated that PTSD and PD/A were the only DSM-IV anxiety disorder constructs to have significant direct effects on AA (in accord with previous findings, the DSM-IV constructs of generalized anxiety disorder, social phobia, and obsessive-compulsive disorder did not have significant structural relationships with AA). The current findings, which attest to the specificity of AA to PTSD and PD/A, are discussed in context of other clinically salient shared features of these disorders and their relevance to treatment and diagnostic classification.

Introduction

Researchers have long recognized the considerable overlap among anxiety and mood disorders at the diagnostic, symptom, and psychometric levels (e.g., Brown & Barlow, 2002; Kendall & Watson, 1989), leading many to question whether anxiety and depression are empirically distinct phenomena (e.g., Andrews, 1996). Based on a comprehensive review of the literature at the time, Clark and Watson (1991) concluded that although anxiety and depression share a significant nonspecific component encompassing general affective distress and other common symptoms, the two constructs could be distinguished by certain unique features. Accordingly, the authors proposed a tripartite model of anxiety and depression consisting of: (1) *negative affect*—comprised of symptoms of general distress such as worry, irritability, and tension; (2) *positive affect*—defined as the level of pleasurable engagement with the environment and characterized by features such as cheerfulness, sociability, and enthusiasm; and (3) *autonomic arousal*—characterized by symptoms such as rapid heart rate, shortness of breath, and trembling. The original tripartite model asserted that negative affect is a shared feature of anxiety and mood disorders (i.e., symptoms of tension, worry, irritability, etc., are present in both anxiety and depression). However, autonomic arousal was viewed as specific to anxiety, whereas low positive affect was posited to differentiate mood disorders from anxiety disorders.

Subsequently, a sizeable literature emerged on the viability of the tripartite structure in adult and child samples (e.g., Brown, Chorpita, & Barlow, 1998; Chorpita, Albano, & Barlow, 1998; Joiner, Catanzaro, & Laurent, 1996; Watson et al., 1995). Although these studies were largely supportive of the tripartite model (e.g., negative affect is a shared feature of the anxiety and mood disorders), several findings led to its reformulation in 1998 (Mineka, Watson, & Clark, 1998). For instance, in a sample of adult outpatients with anxiety and mood disorders, Brown et al. (1998) evaluated the structural relations of selected DSM-IV anxiety and mood disorder constructs (panic disorder/agoraphobia, PD/A; social phobia, SOC; generalized anxiety disorder, GAD; obsessive-compulsive disorder, OCD; unipolar depression, DEP) and dimensions of the tripartite model. Of note, virtually all the considerable covariance of the DSM-IV disorder constructs was explained by the higher-order dimensions of Negative Affect (NA) and Positive Affect (PA). NA evidenced significant paths to all of the disorder constructs, but had its strongest relationships with GAD and DEP (γs = .74 and .67, respectively), as well as PD/A (γ = .65). Counter to the original tripartite model, PA had significant direct effects on both DEP and SOC (γs = −.29 and −.28, respectively). Indeed, the finding that PA

* Corresponding author. Tel.: +1 617 353 9610; fax: +1 617 353 9609.
E-mail address: tabrown@bu.edu (T.A. Brown).

0005-7967/$ – see front matter © 2009 Elsevier Ltd. All rights reserved.
doi:10.1016/j.brat.2009.02.016

is germane to SOC in addition to the mood disorders has been replicated in several studies (e.g., Brown, 2007; Watson, Clark, & Carey, 1998). Finally, the results of Brown et al. (1998) indicated that autonomic arousal (AA) was positively related to PD/A only ($\gamma = .67$). The DSM-IV constructs of OCD and SOC had no unique relation to AA (γs = .02 and −.02, respectively). Whereas DEP also evidenced no relationship with AA, GAD was inversely related to AA (i.e., holding NA constant, an increase in GAD was associated with a decrease in AA). In addition to representing a possible important point of distinction between GAD and mood disorders, this finding is in accord with laboratory studies showing that the process of worry leads to a suppression of autonomic arousal (e.g., Borkovec, Lyonfields, Wiser, & Diehl, 1993).

Based on these and other findings, Mineka et al. (1998) forwarded a hierarchical model of anxiety and depression which revised the tripartite model in the following ways: (a) although NA is a common feature of all emotional disorders, it is more germane to some disorders (e.g., GAD, mood disorders) than to others (e.g., specific phobia); (b) low PA is relevant to both SOC and mood disorders; and (c) high AA is specific to PD/A. Moreover, whereas NA and PA are posited to reflect higher-order dimensions of temperament instrumental in the etiology and course of the emotional disorders (cf. neuroticism and extraversion; Brown, 2007), AA is construed as a lower-order symptom dimension (i.e., a symptom feature that distinguishes PD/A from other emotional disorders).

A salient limitation of the extant literature on the tripartite and hierarchical models is its omission of the major anxiety disorder category, posttraumatic stress disorder (PTSD). To our knowledge, PTSD has not been included in evaluations of the tripartite/hierarchical model to date, and thus its structural relationships with these dimensions are unknown. Nevertheless, there is descriptive evidence suggesting that high AA is not unique to PD/A but is also a prominent feature of PTSD (e.g., Brown, Campbell, Lehman, Grisham, & Mancill, 2001; Davidson & Foa, 1991; Jones & Barlow, 1990; Keane & Barlow, 2002). This phenotypic commonality is reflected by many of the DSM-IV diagnostic criteria for PTSD; namely, the features of re-experiencing (Criterion B; e.g., physiological reactivity on exposure to internal or external cues that symbolize or resemble an aspect of the trauma), and persistent hyperarousal (Criterion D; e.g., hypervigiliance, exaggerated startle response). In addition to the phenomenological similarities between panic attacks and PTSD re-experiencing symptoms (Mellman & Davis, 1985), research has shown that flashbacks can be induced in patients with PTSD by the same laboratory methods of panic provocation used for patients with PD/A (e.g., sodium lactate infusions; Jensen et al., 1997; Rainey et al., 1987). Moreover, researchers (Jones & Barlow, 1990; Keane & Barlow, 2002) have observed that the symptoms comprising the Criterion C cluster of DSM-IV PTSD have salient similarities to the features of PD/A. Specifically, that the numbing of general responsiveness in PTSD (e.g., restricted range of affect, avoidance of thoughts or feelings associated with the trauma) may represent avoidance of aversive emotional reactions and learned alarms ("learned alarms" are conditioned associations between intense basic emotions and thoughts, feelings, or situational reminders of the traumatic event; Keane & Barlow, 2002). These PTSD features are posited to be similar to interoceptive sensitivity and avoidance found in PD/A (i.e., patients with PD/A are reactive to and avoidant of emotions or activities that elicit physical symptoms that are viewed as dangerous or signal an impending panic attack).

The relevance of AA to PTSD is also indicated by the consistent finding that panic attacks are a common psychopathological response and sequelae to trauma. A substantial proportion of persons with PD/A report a history of trauma (e.g., David, Giron, & Mellman, 1995; Falsetti, Resnick, Dansky, Lydiard, & Kilpatrick, 1995; Leskin & Sheikh, 2002). Moreover, research has shown that the majority of trauma survivors experience panic attacks during their trauma (e.g., Bryant & Panasetis, 2001; Nixon & Bryant, 2003; Pfefferbaum, Stuber, Galea, & Fairbrother, 2006), and that the presence of peritraumatic panic attacks is predictive of the development of acute stress disorder (ASD) and PTSD (Bryant & Panasetis, 2001; Nixon & Bryant, 2003; Pfefferbaum et al., 2006). Ongoing panic attacks appear to be common in persons with ASD or PTSD. For instance, Nixon and Bryant (2003) found that 14 of 15 individuals with ASD reported persistent panic attacks compared to only 1 of 15 traumatized individuals without ASD. Falsetti and Resnick (1997) found that 69% (43 of 62) of a treatment-seeking sample of trauma survivors, the majority of whom met diagnostic criteria for PTSD, reported panic attacks during the two weeks preceding the assessment. These findings are bolstered by the results from clinical and epidemiological samples that reveal high current and lifetime diagnostic comorbidity of PTSD and PD/A (e.g., Brown, Campbell, et al., 2001; Kessler, Sonnega, Bromet, Hughes, & Nelson, 1995; Perkonigg, Kessler, Storz, & Wittchen, 2000). For instance, findings from a large-scale ($N = 1127$) comorbidity of outpatients with anxiety and mood disorders (Brown, Campbell, et al., 2001) indicated that the presence of PTSD was associated with a significantly elevated relative risk of PD/A. Indeed, a history of PD/A was present in 60% of patients with lifetime PTSD, a comorbidity pattern that was second only to major depression (82% of lifetime PTSD cases had lifetime major depression).

The goal of the present study was to extend the extant research by examining whether the relevance of AA is specific to PD/A and PTSD. Although the aforementioned descriptive data indicate that the features of AA are common in PTSD (e.g., a high co-occurrence of panic attacks and PD/A), multivariate analyses of this issue were undertaken to determine whether any differential relationships between PTSD (and PD/A) and AA are evident after holding other forms of diagnostic comorbidity and negative affectivity constant (cf. Brown et al., 1998). Thus, the analyses were conducted at both the diagnostic level (i.e., holding other current DSM-IV anxiety disorders constant, is the presence of DSM-IV PTSD and PD/A uniquely predictive of AA?), as well as in context of structural models which involved the dimension of NA and latent continuous variables corresponding to the major DSM-IV anxiety disorder constructs (i.e., extending the results of Brown et al., 1998, does the latent construct of PTSD, in addition to PD/A, have a significant direct effect on AA?).

Method

Participants

The sample consisted of 295 outpatients who presented for assessment or treatment at the Center for Anxiety and Related Disorders at Boston University. Women constituted the larger portion of the sample (70%); average age was 33.93 years (SD = 11.84, range = 18–74). The sample was predominantly Caucasian (88%; African-American = 4%, Asian = 4%, Latino/Hispanic = 3%). Diagnoses were established with the Anxiety Disorders Interview Schedule for DSM-IV: Lifetime version (ADIS-IV-L; Di Nardo, Brown, & Barlow, 1994), a semi-structured interview designed to ascertain reliable diagnosis of the DSM-IV anxiety, mood, somatoform, and substance use disorders, and to screen for the presence of other conditions (e.g., psychotic disorders). For each diagnostic section, the ADIS-IV-L provides dimensional assessment of the key and associated features of disorders (0–8 ratings); in most sections, these features are dimensionally rated regardless of whether a formal DSM-IV diagnosis is under consideration. At the

conclusion of the ADIS-IV-L administration, interviewers also make dimensional ratings (0–8) of each DSM-IV diagnostic criterion for the major anxiety and mood disorder categories. A reliability study ($N = 362$) entailing two independent administrations of the ADIS-IV-L indicated good-to-excellent inter-rater agreement for current anxiety disorders (range of κs = .67 to .86) and their associated dimensional ratings (Brown, Di Nardo, Lehman, & Campbell, 2001). For each diagnosis, interviewers assign a 0–8 clinical severity rating (CSR) that indicates the degree of distress and impairment associated with the disorder (0 = "none" to 8 = "very severely disturbing/disabling"). In patients with two or more current diagnoses, the "principal" diagnosis is the one receiving the highest CSR. For disorders that meet or surpass the threshold for a formal DSM-IV diagnosis, CSRs of 4 ("definitely disturbing/disabling") or higher are assigned ("clinical" diagnoses). Current clinical diagnoses not deemed to be the principal diagnosis are referred to as "additional" diagnoses. The sample rates of current clinical disorders (collapsing across principal and additional diagnoses) that were the focus of the present study are as follows: social phobia (44%), panic disorder with or without agoraphobia (31%), PTSD (31%), generalized anxiety disorder (27%), and obsessive-compulsive disorder (19%). The frequency of generalized anxiety disorder increases to 48% when the DSM-IV hierarchy rule with mood disorders is ignored (cf. Brown, 2007; Brown, Campbell, et al., 2001). Considerable heterogeneity was evident in the types of traumatic events reported by patients with PTSD. The most common trauma types were childhood physical abuse (38%), childhood sexual abuse (25%), rape (23%), transportation accidents (19%), and crime victimization (16%). Other forms of trauma that were reported less frequently included domestic violence (8%), combat (5%), and natural disasters (3%) (because many patients were exposed to more than one trauma, the sum of these percentages exceeds 100%).

Indicators in the structural and regression models

In addition to questionnaire measures of autonomic arousal (AA) and negative affectivity (NA), five DSM-IV disorder constructs were examined in the latent structural models: Panic Disorder/Agoraphobia, Posttraumatic Stress Disorder, Generalized Anxiety Disorder, Social Phobia, and Obsessive-Compulsive Disorder. In the multiple regression models, binary dummy codes reflecting the presence/absence of these five DSM-IV disorders were used as nominal predictors of autonomic arousal. In the structural models, dimensional latent variables of the five DSM-IV disorder constructs were formed by dimensional clinical ratings from the ADIS-IV-L.

Autonomic arousal (AA)

Two measures were used as indicators of autonomic arousal (AA): (a) Beck Anxiety Inventory (BAI; Beck & Steer, 1990); and (b) Anxiety subscale of the 21-item version of the Depression Anxiety Stress Scales (DASS-A; Lovibond & Lovibond, 1995). An extensive body of literature attests to the favorable psychometric properties of the BAI and DASS-A as measures of AA/fearfulness (e.g., Antony, Bieling, Cox, Enns, & Swinson, 1998; Brown, Chorpita, Korotitsch, & Barlow, 1997; Joiner et al., 1999; Lovibond & Lovibond, 1995).

Negative affectivity (NA)

The Negative Affect scale of the Positive and Negative Affect Scales (PANAS-N, "in general" timeframe instructions; Watson, Clark, & Tellegen, 1988) served as an indicator of NA.

Panic Disorder/Agoraphobia (PD/A)

Three indicators were used to form a latent variable representing DSM-IV PD/A: (a) a clinical dimensional rating (0–8) of DSM-IV PD/A Criterion A1 (recurrent panic attacks); (b) a sum composite of dimensional ratings of the three symptoms comprising DSM-IV Criterion A2 (worry/change in behavior); and (c) a sum composite of the ADIS-IV-L dimensional ratings of situational avoidance of or escape from 22 agoraphobic situations (agoraphobia).

Posttraumatic Stress Disorder (PTSD)

The latent variable of DSM-IV PTSD was formed using ADIS-IV-L dimensional ratings of the 17 symptoms comprising DSM-IV Criteria B, C, and D. Numerous factor analytic studies have indicated a latent structure of these symptoms that is not in accord with the organization proffered by DSM-IV (e.g., Simms, Watson, & Doebbeling, 2002). Accordingly, the indicators for the PTSD latent variable were symptom composites created on the basis of the four-factor model presented in Simms et al. (2002): (a) Intrusions—Criteria B1 through B5; (b) Avoidance—Criteria C1 and C2; (c) Dysphoria—Criteria C3 through C7, and Criteria D1 through D3; and (d) Hyperarousal—Criteria D4 and D5.

Generalized Anxiety Disorder (GAD)

A factor of DSM-IV GAD was created using three indicators derived from ADIS-IV-L dimensional ratings (all 0–8 scales): (a) excessiveness of worry in 8 areas (e.g., finances, minor matters); (b) a single rating of difficulty controlling worry (DSM-IV GAD Criterion B); and (c) frequency/severity ratings of the 6 symptoms comprising the DSM-IV associated symptom criterion of GAD.

Social Phobia (SOC)

Indicators of the SOC latent variable were: (a) ADIS-IV-L ratings of patients' fear of 13 social situations (SOCFR; e.g., initiating a conversation, participating at meetings/classes; 0 = "no fear" to 8 = "very severe fear"); and (b) a sum composite of clinical dimensional ratings (0–8) for DSM-IV social phobia Criteria B through D.

Obsessive-Compulsive Disorder (OCD)

The OCD factor was represented by two indicators: (a) a sum composite of ADIS-IV-L dimensional ratings of persistence/distress associated with 9 common obsessions (e.g., doubting, contamination); and (b) a sum composite of ADIS-IV-L dimensional ratings of the frequency of 6 compulsions (e.g., washing, checking).

Data analysis

The raw data were analyzed using a latent variable software program and maximum-likelihood minimization functions (Mplus 5.1, Muthén & Muthén, 1998–2008). Although negligible (average covariance coverage = .970), missing data were accommodated in all analyses using direct maximum likelihood under the assumption of missingness at random (cf. Allison, 2003; Raykov, 2005). Goodness of fit of the models was evaluated using the root mean square error of approximation (RMSEA), and its 90% confidence interval and test of close fit (CFit), the Tucker–Lewis index (TLI), the comparative fit index (CFI), and the standardized root mean square residual (SRMR). Acceptable model fit was defined in part by the criteria forwarded by Hu and Bentler (1999): RMSEA values close to .06 or below (90% CI upper limit close to/$\leq$.06, nonsignificant CFit), CFI and TLI values close to .95 or above, and SRMR values close to .08 or below. Multiple indices were selected because they provide different information for evaluating model fit (i.e., absolute fit, fit adjusting for model parsimony, fit relative to a null model); used together, these indices provide a more conservative and reliable evaluation of model fit. The acceptability of the models was further evaluated by the absence of salient localized areas of strains in the solutions (e.g., modification indices), and the strength and

interpretability of the parameter estimates. Multiple regression analyses were also conducted in Mplus 5.1 using direct maximum likelihood estimation.

Results

Multiple regressions

To determine which of the various DSM-IV anxiety disorders contributed significantly to the prediction of AA, multiple regression analyses were conducted whereby the BAI and DASS-A were regressed onto five dummy codes representing the presence/absence (1/0) of DSM-IV PD/A, PTSD, GAD, SOC, and OCD. As shown in Table 1, the five DSM-IV anxiety disorders collectively accounted for 20% of the variance in the BAI ($p < .001$). However, only the presence of DSM-IV PD/A and PTSD was uniquely predictive of the BAI ($ps < .001$). For instance, holding other DSM-IV anxiety disorders constant, the presence of PD/A was associated with a 10.73 unit increase in the BAI; the presence of DSM-IV PTSD uniquely led to a 7.73 unit increase in the BAI.

Similar findings were obtained using the DASS-A as the outcome. Collectively, the five DSM-IV anxiety disorders explained 18% of the DASS-A variance. As before, the partial unstandardized regression coefficients were positively signed and statistically significant for DSM-IV PD/A ($p < .001$) and PTSD ($p < .01$) indicating that the presence of these conditions was uniquely associated with significant increases in DASS-A. In this model, DSM-IV SOC also accounted for significant unique variance in the DASS-A ($p < .05$).[1]

Structural equation models

A confirmatory factor analysis (CFA) was conducted to evaluate a measurement model comprised of latent variables corresponding to the five DSM-IV anxiety disorder constructs (PD/A, PTSD, GAD, SOC, OCD), autonomic arousal (AA), and negative affect (NA). Because NA was defined by a single indicator (PANAS-N), measurement error in this variable was adjusted for by fixing its error variance on the basis of the PANAS-N's sample variance ($s^2 = 72.64$) and internal consistency estimate ($\alpha = .883$) (cf. Brown, 2006). Although descriptive goodness of fit statistics indicated that the seven-factor measurement model fit the data well, a salient modification index (25.44) indicated that fit could be significantly improved by freeing the error covariance of the excessive worry and uncontrollability indicators of GAD (owing to the differential relationship between these two indicators of worry, relative to the associated symptoms of GAD). The global goodness of fit of this revised solution was also satisfactory, $\chi^2(98) = 170.40$, $p < .001$, SRMR = .05, RMSEA = .05 (CFit $p = .48$), TLI = .97, CFI = .98. The completely standardized factor loading estimates from this solution are presented in Table 2 (range of $\lambda s = .67$ to .97; all $ps < .001$).

Finally, a structural regression model was fit to the data whereby NA was specified as a higher-order dimension of the DSM-IV anxiety disorder constructs and in which the AA factor was regressed onto the DSM-IV disorder latent constructs and NA (see Fig. 1).[2] Except for a correlated disturbance between GAD and OCD (owing to the differential phenotypic overlap of excessive worry and obsessions; cf. Brown et al., 1998), this model specification assumes that all the covariance among the DSM-IV anxiety disorder constructs can be accounted for by NA. Moreover, it was predicted that when holding NA constant, only PD/A and PTSD would evidence positive and statistically significant structural paths to AA. This model fit the data well, $\chi^2(107) = 209.41$, $p < .001$, SRMR = .06, RMSEA = 0.06 (CFit = .15), TLI = .96, CFI = .97. Completely standardized estimates from this solution are presented in Fig. 1. Collectively, the five DSM-IV disorder constructs and NA explained 64% of the variance in AA. Consistent with prediction, PD/A and PTSD were the only DSM-IV disorder constructs that explained significant unique variance in AA ($\gamma s = .36$ and .14, respectively; $ps < .001$ and .01). In fact, the regression paths for GAD, SOC, and OCD were virtually zero (range = −.04 to .02) indicating the lack of relevance of these DSM-IV constructs to the prediction of AA. NA explained the covariance among the DSM-IV disorder constructs, except for GAD and OCD where the magnitude of the correlated disturbance ($\Psi = .18$) was virtually identical to the corresponding parameter estimate obtained in Brown et al. (1998). Whereas all DSM-IV disorder constructs were significantly predicted by NA, these effects varied in magnitude with GAD evidencing the strongest relationship with NA ($\gamma = .63$).

Table 1
Multiple regression models evaluating the multivariate relationships between current DSM-IV diagnostic status and autonomic arousal ($N = 295$).

Dependent measure: Beck Anxiety Inventory	*B*	SE_B	*t*
Predictor:			
Panic disorder/agoraphobia	10.73	1.71	6.26***
Posttraumatic stress disorder	7.73	1.67	4.63***
Generalized anxiety disorder	2.23	1.55	1.44
Social phobia	3.03	1.61	1.89
Obsessive-compulsive disorder	1.92	1.96	0.98
Constant:	14.28	1.48	9.65***
Model $R^2 = .20$, $p < .001$			
Dependent measure: DASS Anxiety			
Predictor:			
Panic disorder/agoraphobia	4.37	0.64	6.84***
Posttraumatic stress disorder	1.94	0.62	3.12**
Generalized anxiety disorder	0.38	0.57	0.66
Social phobia	1.48	0.59	2.50*
Obsessive-compulsive disorder	0.45	0.72	0.63
Constant:	4.46	0.54	8.19***
Model $R^2 = .18$, $p < .001$			

Note. DASS = Depression Anxiety Stress Scales. *$p < .05$, **$p < .01$, ***$p < .001$.

Discussion

In accord with prediction and prior descriptive evidence (e.g., Brown, Campbell, et al., 2001; Nixon & Bryant, 2003), the current findings attest to the relevance of AA to PTSD, in addition to PD/A. Significant direct effects of PTSD on AA were obtained even when controlling for PD/A and other forms of comorbidity at the DSM-IV diagnostic level (i.e., multiple regressions, Table 1), and in an

[1] All multiple regression and structural equation models were also conducted using rescored BAI and DASS-A measures whereby only physiological symptoms of AA were included (e.g., on the BAI, several cognitive/subjective fear items were removed such as "fear of the worst happening" and "fear of dying"). In all analyses, the pattern of results remained unchanged (i.e., PD/A and PTSD continued to explain significant unique variance in the AA outcomes, no other disorder constructs contributed to the prediction of AA). Compared to the analyses using the full BAI and DASS-A scales, the only discordant result was that the regression coefficient for the social phobia diagnosis was no longer statistically significant ($p = .33$) when the rescored DASS-A was used as the dependent variable (cf. Table 1).

[2] Although the hierarchical model also entails the construct of positive affectivity (PA), PA was not included in the analyses presented in this paper due to the lack of posited relationships with PTSD and PD/A. However, a model that included PA as a higher-order dimension in addition to NA was fit to the data. The results of this analysis, which are available upon request, verified the absence of structural relationships of PA with PTSD and PD/A (i.e., consistent with prior research, PA had a significant path to SOC only; cf. Brown et al., 1998).

Table 2
Factor loadings (completely standardized) for measurement model of Posttraumatic Stress Disorder, Panic Disorder/Agoraphobia, Generalized Anxiety Disorder, Social Phobia, Obsessive-Compulsive Disorder, Autonomic Arousal, and Negative Affect ($N = 295$).

	Factor loading
Posttraumatic Stress Disorder	
Intrusions	.80
Avoidance	.79
Hyperarousal	.91
Dysphoria	.79
Panic Disorder/Agoraphobia	
Recurrent panic attacks	.93
Worry/change of behavior	.97
Agoraphobia	.71
Generalized Anxiety Disorder	
Excessive worry	.69
Uncontrollability of worry	.67
Associated symptoms	.97
Social Phobia	
Fear of social situations	.95
Interference/distress	.91
Obsessive-Compulsive Disorder	
Obsessions	.81
Compulsions	.87
Autonomic Arousal	
BAI	.90
DASS-A	.87
Negative Affect	
PANAS-N	.94[a]

Note. BAI = Beck Anxiety Inventory; DASS-A = Depression Anxiety Stress Scales—Anxiety scale; PANAS-N = Negative Affect Scale; all factor loadings significant at $p < .001$.
[a] Error variance of single indicator constrained (unstandardized theta = 8.56).

analytic model of the structural relationships among latent variables corresponding to the DSM-IV anxiety disorder constructs and NA (Fig. 1). Although prior findings have shown that panic attacks and PD/A are common in persons with PTSD (e.g., Brown, Campbell, et al., 2001; Falsetti & Resnick, 1997; Nixon & Bryant, 2003), the current multivariate analyses indicate that the differential relationship of PTSD and AA is not due to this comorbidity (i.e., holding

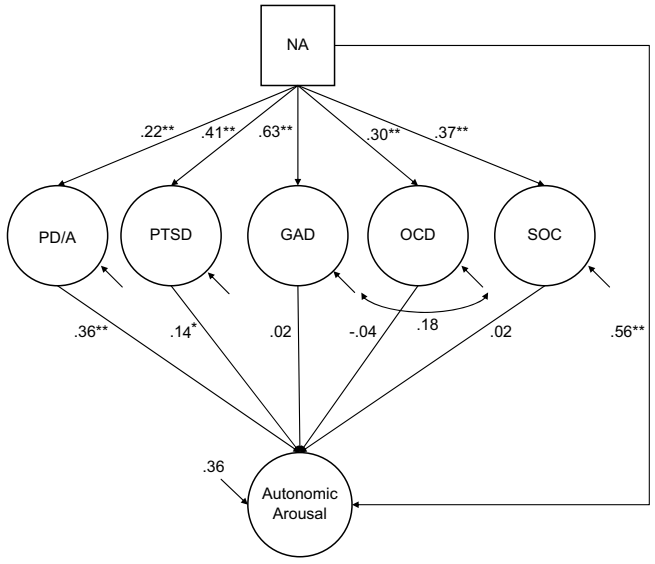

Fig. 1. Latent structural model of the relationships between DSM-IV anxiety disorder constructs and autonomic arousal. *Note*: PD/A = Panic Disorder/Agoraphobia, PTSD = Posttraumatic Stress Disorder, GAD = Generalized Anxiety Disorder, SOC = Social Phobia, OCD = Obsessive-Compulsive Disorder, NA = Negative Affect. Completely standardized estimates are shown. $^{*}p < .01$; $^{**}p < .001$.

PD/A constant in the multiple regression and structural models, PTSD continued to have a significant direct effect on AA).

Also consistent with previous research (e.g., Brown et al., 1998) are the findings that major anxiety disorders other than PD/A and PTSD are not uniquely predictive of AA (e.g., in the structural model, paths from OCD, GAD, and SOC were −.04, .02, and .02, respectively; however, SOC did have a significant direct effect on AA in one multiple regression model, but see Footnote 1). Because panic attacks are common in other anxiety disorders (e.g., a person with specific phobia may experience a panic attack upon unexpected confrontation with a feared object such as a large, barking dog; cf. Barlow, Brown, & Craske, 1994), the question arises as to why is a significant association with AA unique to PD/A and PTSD. Unlike other anxiety disorders, PD/A and PTSD are characterized by *persistent* hyperarousal and hypervigilance (e.g., a person with specific phobia is not apt to experience high AA in the absence of the feared object/situation). Indeed, a shared feature of PD/A and PTSD is that the cues conditioned to elicit re-experiencing symptoms in PTSD and the cues conditioned to elicit panic attacks in PD/A cannot be readily avoided (e.g., physical sensations, strong emotions, memories). Thus, persons with PTSD and PD/A are more prone to experience chronic hyperarousal because, relative to other anxiety disorders, their fear cues are perceived to be less controllable. Because persons with PTSD and PD/A have a diminished sense of control over their exposure to fear cues (relative to persons with disorders such as SOC and specific phobia, where behavioral avoidance of phobic situations may be successful at limiting exposure to fear cues), acute episodes involving high AA are more likely (i.e., re-experiencing symptoms in PTSD, panic attacks in PD/A). As noted earlier in this paper, the relevance of these internal fear cues has led to the recognition of other important similarities between PTSD and PD/A (i.e., the phenotypal and functional overlap of the symptoms of numbing of general responsiveness in PTSD and the symptoms of interoceptive sensitivity in PD/A; Feldner, Vujanovic, Gibson, & Zvolensky, 2008; Jones & Barlow, 1990; Keane & Barlow, 2002; Smith & Bryant, 2000). Accordingly, some investigators have striven to enhance the efficacy of psychological interventions for PTSD by incorporating treatment elements originally developed for PD/A (e.g., interoceptive exposure; Falsetti & Resnick, 2000; Falsetti, Resnick, & Davis, 2001, 2008; Teng et al., 2008; Wald & Taylor, 2008).

These collective similarities, as well as other evidence (e.g., history of trauma in patients with PD/A, frequency of peritraumatic and persistent panic in ASD/PTSD, high diagnostic comorbidity of PTSD and PD/A) have led some researchers to ponder whether trauma exposure or the diagnosis of ASD/PTSD serve as risk factors for PD/A (e.g., Brown, Campbell, et al., 2001; Falsetti et al., 1995; Leskin & Sheikh, 2002; Nixon & Bryant, 2003). For instance, in addition to obtaining a high lifetime DSM-IV diagnostic comorbidity rate between these two disorders, Brown, Campbell, et al. (2001) conducted temporal sequence analyses indicating that the onset of PD/A less frequently preceded PTSD than the converse (i.e., PD/A occurred before PTSD in 28% of comorbid cases). The authors interpreted these findings in accord with a possible "PTSD as risk for PD/A" conceptual model; namely, that the high AA and low perceptions of personal control found in PTSD, perhaps coupled with a pre-existing trait such as anxiety sensitivity, give rise to PD/A. Evidence suggesting that PTSD and PD/A have shared neurobiological underpinnings (e.g., Ellen, Olver, Norman, & Burrows, 2008; Kellner, & Yehuda, 1999; Kent, Sullivan, & Rauch, 2000) and trait vulnerabilities (e.g., anxiety sensitivity; Asmundson & Stapleton, 2008; Lang, Kennedy, & Stein, 2002; Nixon & Bryant, 2003; Taylor, Koch, & McNally, 1992) might be viewed as lending support for this or alternative conceptual accounts for the differential aggregation of PTSD and PD/A.

These findings have other implications to future diagnostic classification systems beyond informing theoretical models of comorbidity. For example, it has been proposed that the anxiety and mood disorders be re-organized in DSM-V based on their differential associations at the diagnostic and psychometric level. At the present time, one of the most prominent of these proposals was forwarded by Watson (2005) who contends that extant psychometric evidence (e.g., factor analyses of lifetime comorbidity data) supports the subclassification of anxiety and mood disorders as follows: (1) "fear disorders" (i.e., PD/A, SOC, specific phobia); (2) "distress disorders" (i.e., GAD, PTSD, major depression, dysthymia); and "bipolar disorders" (i.e., bipolar I, bipolar II, cyclothymia). No firm conclusions were offered in regard to the placement of OCD, although Watson (2005) highlighted preliminary evidence that could support the classification of OCD as a fear disorder. The current study's results, as well as other findings (for reviews, see Brown, in press; Brown & Barlow, 2005), could be viewed as inconsistent with this proposed reorganization. For instance, this taxonomy would disassociate PD/A and PTSD, conditions that can be distinguished from the other anxiety and mood disorders by high AA, and possibly other features (e.g., anxiety sensitivity). Moreover, this proposal classifies SOC, specific phobia, and perhaps OCD as fear disorders, but the current findings and prior research indicate that AA is not germane to these conditions (e.g., see also Brown et al., 1997, 1998). In the Watson (2005) taxonomy, GAD, PTSD, and the unipolar mood disorders are classified as distress disorders because these conditions "contain a very large component of nonspecific negative affectivity." Although this conclusion is partially supported by the current results (i.e., NA had its largest direct effects on GAD and PTSD, γs = .63 and .41, respectively; see Fig. 1), it is not fully reflective of the compelling evidence that NA is relevant to all emotional disorders and that some conditions in addition to GAD, PTSD, and unipolar depression have comparable structural associations with NA (e.g., direct effect of NA on SOC = .37, Fig. 1; see also Brown, 2007; Brown et al., 1998).

In any case, by demonstrating the specificity of AA to PD/A and PTSD, the current findings add to a growing body of literature that attests to the many clinically salient similarities of these two conditions. Although these similarities have been recognized by treatment outcome researchers (e.g., Falsetti et al., 2001; Teng et al., 2008; Wald & Taylor, 2008), it may be important for future classification systems to also address this overlap, especially if efforts move forward in DSM-V or elsewhere to subclassify the existing emotional disorder categories on the basis of their differential comorbidity, feature overlap, or other aspects (e.g., shared neurobiological or genetic vulnerabilities). However, additional research is needed to evaluate the functional and directional relationships of trauma exposure/PTSD and PD/A. Whereas the prevailing view is that trauma exposure/PTSD serve as a risk factor for panic attacks and PD/A, empirical inquiry of this conceptualization has been limited to cross-sectional designs (e.g., retrospective report of trauma history in patients with PD/A, retrospective analysis of the temporal sequence of PTSD and PD/A onsets in comorbid cases). Thus, longitudinal studies would offer a more compelling test of this and alternative conceptual accounts for the comorbidity and phenotypal overlap of PTSD-PD/A (e.g., rather than directional causal effects between these disorders, is the comorbidity/overlap in PTSD and PD/A explained by the existence of shared pre-existing vulnerabilities?).

Acknowledgments

The authors thank the following individuals for their assistance with this study: Amy E. Lawrence, Anthony J. Rosellini, Ovsanna Leyfer, and Cathryn M. Freid.

References

Allison, P. D. (2003). Missing data techniques for structural equation modeling. *Journal of Abnormal Psychology, 112*, 545–557.

Andrews, G. (1996). Comorbidity in neurotic disorders: The similarities are more important than the differences. In R. M. Rapee (Ed.), *Current controversies in the anxiety disorders* (pp. 3–20). New York: Guilford Press.

Antony, M. M., Bieling, P. J., Cox, B. J., Enns, M. W., & Swinson, R. P. (1998). Psychometric properties of the 42-item and 21-item versions of the Depression Anxiety Stress Scales in clinical groups and a community sample. *Psychological Assessment, 10*, 176–181.

Asmundson, G. J. G., & Stapleton, J. A. (2008). Associations between dimensions of anxiety sensitivity and PTSD symptom clusters in active-duty police officers. *Cognitive Behaviour Therapy, 37*, 66–75.

Barlow, D. H., Brown, T. A., & Craske, M. G. (1994). Definitions of panic attacks and panic disorder in DSM-IV: Implications for research. *Journal of Abnormal Psychology, 103*, 553–564.

Beck, A. T., & Steer, R. A. (1990). *Manual for the Beck Anxiety Inventory*. San Antonio, TX: Psychological Corporation.

Borkovec, T. D., Lyonfields, J. D., Wiser, S. L., & Diehl, L. (1993). The role of worrisome thinking in the suppression of cardiovascular response to phobic imagery. *Behaviour Research and Therapy, 31*, 321–324.

Brown, T.A. (in press). The boundary between generalized anxiety disorder and the unipolar mood disorders: Diagnostic and psychometric findings in clinical samples. In D. Goldberg, K.S. Kendler, P. Sirovatka, & D.A. Regier (Eds.), *Diagnostic issues in depression and generalized anxiety disorder: Refining the research agenda for DSM-V*. Arlington, VA: American Psychiatric Association.

Brown, T. A. (2006). *Confirmatory factor analysis for applied research*. New York: Guilford Press.

Brown, T. A. (2007). Temporal course and structural relationships among dimensions of temperament and DSM-IV anxiety and mood disorder constructs. *Journal of Abnormal Psychology, 116*, 313–328.

Brown, T. A., & Barlow, D. H. (2002). Classification of anxiety and mood disorders. In D. H. Barlow (Ed.), *Anxiety and its disorders: The nature and treatment of anxiety and panic* (2nd ed.) (pp. 292–327). New York: Guilford Press.

Brown, T. A., & Barlow, D. H. (2005). Categorical *vs* dimensional classification of mental disorders in *DSM-V* and beyond. *Journal of Abnormal Psychology, 114*, 551–556.

Brown, T. A., Campbell, L. A., Lehman, C. L., Grisham, J. R., & Mancill, R. B. (2001). Current and lifetime comorbidity of the DSM-IV anxiety and mood disorders in a large clinical sample. *Journal of Abnormal Psychology, 110*, 585–599.

Brown, T. A., Chorpita, B. F., & Barlow, D. H. (1998). Structural relationships among dimensions of the DSM-IV anxiety and mood disorders and dimensions of negative affect, positive affect, and autonomic arousal. *Journal of Abnormal Psychology, 107*, 179–192.

Brown, T. A., Chorpita, B. F., Korotitsch, W., & Barlow, D. H. (1997). Psychometric properties of the Depression Anxiety Stress Scales (DASS) in clinical samples. *Behaviour Research and Therapy, 35*, 79–89.

Brown, T. A., Di Nardo, P. A., Lehman, C. L., & Campbell, L. A. (2001). Reliability of DSM-IV anxiety and mood disorders: Implications for the classification of emotional disorders. *Journal of Abnormal Psychology, 110*, 49–58.

Bryant, R. A., & Panasetis, P. (2001). Panic symptoms during trauma and acute stress disorder. *Behaviour Research and Therapy, 39*, 961–966.

Chorpita, B. F., Albano, A. M., & Barlow, D. H. (1998). The structure of negative emotions in a clinical sample of children and adolescents. *Journal of Abnormal Psychology, 107*, 74–85.

Clark, L. A., & Watson, D. (1991). Tripartite model of anxiety and depression: Psychometric evidence and taxonomic implications. *Journal of Abnormal Psychology, 100*, 316–336.

David, D., Giron, A., & Mellman, T. A. (1995). Panic-phobic patients and developmental trauma. *Journal of Clinical Psychiatry, 56*, 113–117.

Davidson, J. R., & Foa, E. B. (1991). Diagnostic issues in posttraumatic stress disorder: Considerations for the DSM-IV. *Journal of Abnormal Psychology, 100*, 346–355.

Di Nardo, P. A., Brown, T. A., & Barlow, D. H. (1994). *Anxiety Disorders Interview Schedule for DSM-IV*: Lifetime Version (ADIS-IV-L). New York: Oxford University Press.

Ellen, S., Olver, J., Norman, T., & Burrows, G. D. (2008). The neurobiology of benzodiazepine receptors in panic disorder and posttraumatic stress disorder. *Stress and Health, 24*, 13–21.

Falsetti, S. A., & Resnick, H. S. (1997). Frequency and severity of panic attack symptoms in a treatment seeking sample of trauma victims. *Journal of Traumatic Stress, 10*, 683–689.

Falsetti, S. A., & Resnick, H. S. (2000). Cognitive-behavioral treatment for PTSD with comorbid panic attacks. *Journal of Contemporary Psychotherapy, 30*, 163–179.

Falsetti, S. A., Resnick, H. S., Dansky, B. S., Lydiard, R. B., & Kilpatrick, D. G. (1995). The relationship of stress to panic disorder: Cause or effect. In C. M. Mazure (Ed.), *Does stress cause psychiatric illness?* (pp. 111–147). Washington, DC: American Psychiatric Press.

Falsetti, S. A., Resnick, H. S., & Davis, J. (2001). Multiple channel exposure therapy: Combining cognitive-behavioral therapies for the treatment of posttraumatic stress disorder with panic attacks. *Behavior Modification, 29*, 70–94.

Falsetti, S. A., Resnick, H. S., & Davis, J. (2008). An investigation of the long-term effectiveness of multiple channel exposure therapy for the treatment of PTSD with comorbid panic attacks. *Cognitive Behaviour Therapy, 37*, 117–130.

Feldner, M. T., Vujanovic, A. A., Gibson, L. E., & Zvolensky, M. J. (2008). Posttraumatic stress disorder and anxious and fearful reactivity to bodily arousal: A test of the mediating role of nicotine withdrawal severity among daily smokers in 12-hr nicotine deprivation. *Experimental and Clinical Psychopharmacology, 16*, 144–155.

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.

Jensen, C. F., Keller, T. W., Peskind, E. R., McFall, M. E., Veith, R. C., Martin, D., Wilkinson, C. W., & Raskind, M. A. (1997). Behavioral and neuroendocrine responses to sodium lactate infusion in subjects with posttraumatic stress disorder. *American Journal of Psychiatry, 154*, 266–268.

Joiner, T. E., Catanzaro, S. J., & Laurent, J. (1996). Tripartite structure of positive and negative affect, depression, and anxiety in child and adolescent psychiatric inpatients. *Journal of Abnormal Psychology, 105*, 401–409.

Joiner, T. E., Steer, R. A., Beck, A. T., Schmidt, N. B., Rudd, M. D., & Catanzaro, S. J. (1999). Physiological hyperarousal: Construct validity of a central aspect of the tripartite model of depression and anxiety. *Journal of Abnormal Psychology, 108*, 290–298.

Jones, J. C., & Barlow, D. H. (1990). The etiology of posttraumatic stress disorder. *Clinical Psychology Review, 10*, 299–328.

Keane, T. M., & Barlow, D. H. (2002). Posttraumatic stress disorder. In D. H. Barlow (Ed.), *Anxiety and its disorders: The nature and treatment of anxiety and panic* (2nd ed.) (pp. 418–453). New York: Guilford Press.

Kellner, M., & Yehuda, R. (1999). Do panic disorder and posttraumatic stress disorder share a common psychoneuroendocrinology? *Psychoneuroendocrinology, 24*, 485–504.

Kendall, P. C., & Watson, D. (Eds.). (1989). *Anxiety and depression: Distinctive and overlapping features*. San Diego, CA: Academic Press.

Kent, J. M., Sullivan, G. M., & Rauch, S. L. (2000). The neurobiology of fear: Relevance to panic disorder and posttraumatic stress disorder. *Psychiatric Annals, 30*, 733–742.

Kessler, R. C., Sonnega, A., Bromet, E., Hughes, M., & Nelson, C. B. (1995). Posttraumatic stress disorder in the National Comorbidity Survey. *Archives of General Psychiatry, 52*, 1048–1060.

Lang, A. J., Kennedy, C. M., & Stein, M. B. (2002). Anxiety sensitivity and PTSD among female victims of intimate partner violence. *Depression and Anxiety, 16*, 77–83.

Leskin, G. A., & Sheikh, J. I. (2002). Lifetime trauma history and panic disorder: Findings from the National Comorbidity Survey. *Journal of Anxiety Disorders, 16*, 599–603.

Lovibond, P. F., & Lovibond, S. H. (1995). The structure of negative emotional states: Comparison of the Depression Anxiety Stress Scales (DASS) with the Beck Depression and Anxiety Inventories. *Behaviour Research and Therapy, 33*, 335–342.

Mellman, T. A., & Davis, G. C. (1985). Combat-related flashbacks in posttraumatic stress disorder: Phenomenology and similarity to panic attacks. *Journal of Clinical Psychiatry, 46*, 379–382.

Mineka, S., Watson, D., & Clark, L. A. (1998). Comorbidity of anxiety and unipolar mood disorders. *Annual Review of Psychology, 49*, 377–412.

Muthén, L.K., & Muthén, B.O. (1998–2008). Mplus 5.1 [Computer software]. Los Angeles: Author.

Nixon, R. D. V., & Bryant, R. A. (2003). Peritraumatic and persistent panic attacks in acute stress disorder. *Behaviour Research and Therapy, 41*, 1237–1242.

Perkonigg, A., Kessler, R. C., Storz, S., & Wittchen, H. U. (2000). Traumatic events and posttraumatic stress disorder in the community: Prevalence, risk factors, and comorbidity. *Acta Psychiatric Scandinavia, 101*, 46–59.

Pfefferbaum, B., Stuber, J., Galea, S., & Fairbrother, G. (2006). Panic reactions to terrorist attacks and probable posttraumatic stress disorder in adolescents. *Journal of Traumatic Stress, 19*, 217–228.

Rainey, J. M., Aleem, A., Ortiz, A., Yerigani, V., Pohl, R., & Berchou, R. (1987). A laboratory procedure for the induction of flashbacks. *American Journal of Psychiatry, 144*, 1317–1319.

Raykov, T. (2005). Analysis of longitudinal studies with missing data using covariance structure modeling with full-information maximum likelihood. *Structural Equation Modeling, 12*, 493–505.

Simms, L. J., Watson, D., & Doebbling, B. N. (2002). Confirmatory factor analyses of posttraumatic stress symptoms in deployed and non-deployed veterans of the Gulf War. *Journal of Abnormal Psychology, 111*, 637–647.

Smith, K., & Bryant, R. A. (2000). The generality of cognitive bias in acute stress disorder. *Behaviour Research and Therapy, 38*, 709–715.

Taylor, S., Koch, W. J., & McNally, R. J. (1992). How does anxiety sensitivity vary across the anxiety disorders? *Journal of Anxiety Disorders, 6*, 249–259.

Teng, E. J., Bailey, S. D., Chaison, A. D., Petersen, N. J., Hamilton, J. D., & Dunn, N. J. (2008). Treating comorbid panic disorder in veterans with posttraumatic stress disorder. *Journal of Consulting and Clinical Psychology, 76*, 704–710.

Wald, J., & Taylor, S. (2008). Responses to interoceptive exposure in people with posttraumatic stress disorder: A preliminary analysis of induced anxiety reactions and trauma memories and their relationship to anxiety sensitivity and PTSD symptom severity. *Cognitive Behaviour Therapy, 37*, 90–100.

Watson, D. (2005). Rethinking the mood and anxiety disorders: A quantitative hierarchical model for DSM-V. *Journal of Abnormal Psychology, 114*, 522–536.

Watson, D., Clark, L. A., & Carey, G. (1988). Positive and negative affectivity and their relation to the anxiety and depressive disorders. *Journal of Abnormal Psychology, 97*, 346–353.

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology, 54*, 1063–1070.

Watson, D., Clark, L. A., Weber, K., Assenheimer, J. S., Strauss, M. E., & McCormick, R. A. (1995). Testing a tripartite model: II. Exploring the symptom structure of anxiety and depression in student, adult, and patient samples. *Journal of Abnormal Psychology, 104*, 15–25.