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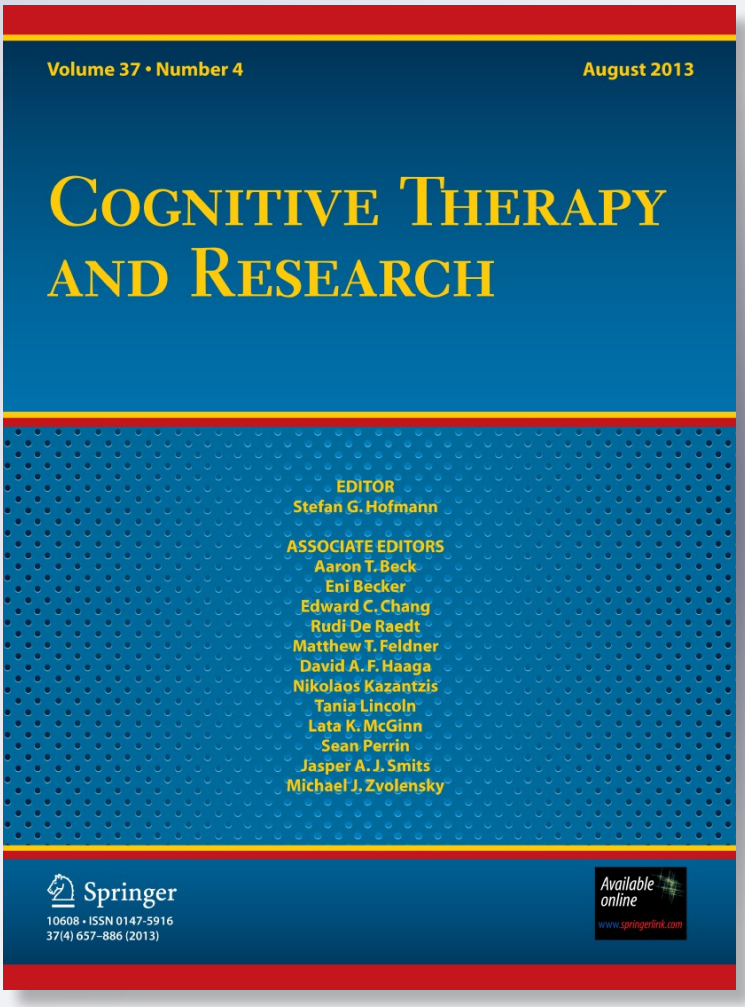

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ORIGINAL ARTICLE

The Interactive Effect of Worry and Intolerance of Uncertainty on Posttraumatic Stress Symptoms

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Abstract In this study, relations among worry, intolerance of uncertainty (IU), and posttraumatic stress symptoms (PTSS) were examined in $N = 89$ participants with a trauma history. Both worry and IU shared significant zero-order correlations with each of the three *DSM-IV* posttraumatic stress symptom clusters. Partial correlations, controlling for the overlap among the symptom clusters, suggested that both worry and IU shared unique associations only with hyperarousal. Finally, and consistent with predictions, IU moderated the relation between worry and PTSS. When examining each PTSS cluster separately, evidence of the moderating role of IU was found only in relation to hyperarousal. More specifically, simple effects revealed that worry had a significant positive association with PTSS and hyperarousal only at high levels of IU. These findings suggest a specific risk profile of high worry in conjunction with high IU for the development and maintenance of PTSS, with particular relevance to hyperarousal symptoms. Conceptual and practical implications of these findings regarding common PTSD treatment approaches are discussed.

Keywords Intolerance of uncertainty · Worry · Posttraumatic stress disorder · PTSD · Trauma

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Introduction

For people who experience a trauma, many factors may differentiate those who develop posttraumatic stress disorder (PTSD) from those who do not. Among them, worry has garnered increased attention. Worry correlates positively with PTSD symptom severity among motor vehicle accident survivors and combat veterans (Bennett et al. 2009; Pietrzak et al. 2011); worry predicts PTSD at 4–6 months posttrauma in traffic accident survivors (Holeva et al. 2001); worry predicts posttraumatic stress symptoms (PTSS; symptoms conceptualized continuously rather than categorically) three months after exposure to a significant life stressor among college students (Roussis and Wells 2008). Theoretical accounts of the role of worry in the development of psychopathology (e.g., Newman and Llera 2011) suggest that worry increases attention to perceived threat and reduces higher-order cognitive resources needed for emotional processing of a traumatic experience. This interference and reallocation of attention is thought to increase the likelihood that one will develop PTSS (i.e., reexperiencing, avoidance, hyperarousal).

According to Newman and Llera's (2011) contrast avoidance model, worry is used as a regulatory strategy to avoid experiencing negative emotional contrast. That is, the purpose of worry is not necessarily to reduce negative emotions per se, but rather to keep a steady emotional state, even if that emotional state is unpleasant. In this model, chronic worriers prefer a constant *negative* emotional state over the chance of an increase in negative affect, especially because they perceive themselves as lacking the necessary emotion regulation abilities to cope with such fluctuations. For example, an assault survivor may believe that cognitive vigilance via worry protects against future assaults. Attention to perceived threat and exacerbation in the tendency to

worry may increase, thus resulting in a heightened level of arousal. Due to the cyclical nature of worry and attentional bias for threat, increased arousal may become chronic. Worry is thus reinforced through the perception of control: *Feared emotional contrast can be avoided if only I worry excessively beforehand*. When the individual confronts a threatening situation, an increase in arousal is less likely than had s/he not already been worrying preemptively.

The use of worry to avoid a negative emotional contrast may result in attentional fixation on threat (Wells and Matthews 1994) and hyperarousal, which evidence suggests may determine the course of posttraumatic pathology (Marshall et al. 2006). Consistent with this line of reasoning, difficulty disengaging from threat-stimuli has been observed in individuals with higher levels of PTSS (Bardeen and Orcutt 2011; Pineles et al. 2009). Research suggests that a bias for attending to threat is an important facet of worry, leading to increased selective attention to negative stimuli and more frequent worrisome thoughts (Hirsch et al. 2011). Regulatory strategies such as worry and attentional fixation are proposed to drain finite cognitive resources, thus reducing the availability of resources for flexible processing of emotion-laden trauma information (Holeva et al. 2001). Indeed, individuals with higher PTSS show greater emotion regulation deficits than those with lower PTSS (Tull et al. 2007).

Worry drains cognitive resources, thus maintaining PTSS by reducing the potential for emotional processing. Given the importance of emotional processing in reducing PTSS (Foa and Kozak 1986), understanding the nature of worry-PTSS relations might aid in the development of worry-related interventions for PTSD. It is not yet known whether worry relates differentially to the *DSM* PTSD symptom clusters. As described, Newman and Llera (2011) suggest that worry may be especially relevant to the PTSD symptom cluster of hyperarousal, implying that those who use worry as a regulatory strategy are more likely to develop an increased set-point of arousal (hyperarousal) and a bias for attending to perceived threat (hypervigilance). However, reduced emotional variability (absence of negative emotional contrast) appears consistent with PTSD numbing symptoms and behavioral avoidance may be used as a strategy to maintain limited emotional contrast. Thus, worry may not be specific to hyperarousal, but broadly relevant to all PTSD symptom clusters. In order to extinguish pathological fear, one's level of arousal must be in an optimal range, not over- or under-engaged (Foa and Kozak 1986). The absence of emotional contrast during exposure may itself preclude emotional processing. Examining specific associations between worry and these three symptom clusters may have key conceptual and therapeutic implications, potentially leading to greater insight into how worry may preclude emotional processing and consequently hinder exposure-based interventions for PTSD.

Beyond examining the relationship between worry and each PTSD symptom cluster, it is important to explore under what conditions worry relates to PTSS. Worry might be especially relevant to PTSS when an individual is highly intolerant of uncertainty. The definition of intolerance of uncertainty (IU) has undergone several revisions since its inception (Birrell et al. 2011). Dugas and Robichaud (2007) described IU as a "characteristic that results from a set of negative beliefs about uncertainty and its implications" (p. 24). A strong positive association between worry and IU has been observed; thus, IU has been suggested as fundamental to the experience of worry and vice versa (Koerner and Dugas 2006). Moreover, greater IU is linked to multiple anxiety disorders (e.g., generalized anxiety, obsessive–compulsive, social anxiety, panic) and depression (Carleton et al. 2012). Given the apparent transdiagnostic applicability of IU, an examination of its potential associations with PTSS would be informative. Because traumatic events often involve uncertainty, IU may be a strong candidate as an individual difference variable related to PTSD. Indeed, the few studies that have examined an IU-PTSD link have identified a positive association between IU and (a) combat-related PTSD in military veterans (Smith 2007) and (b) postpsychotic PTSD in individuals with schizophrenia (White and Gumley 2009).

IU may contribute to the experience of PTSD by maintaining one's sense of current threat (i.e., hypervigilance), further draining finite cognitive resources and resulting in a decreased ability to emotionally process trauma experiences (White and Gumley 2009). For example, individuals with high IU have a bias for attending to information denoting uncertainty and are more likely to interpret ambiguous situations as threatening (Dugas et al. 2005). Since IU is associated with elevated cognitive rehearsal for feared outcomes (worry; Koerner and Dugas 2006), the combined effect of IU and worry may be especially detrimental, resulting in an extreme deficit of available higher-order cognitive resources to process trauma information in a flexible and integrative manner (i.e., emotional processing), thus maintaining PTSS.

Further supporting the need for an examination of the interactive effect of worry and IU on PTSS, Boelen (2010) found that although both worry and IU positively correlated with PTSS among individuals who had experienced the death of a loved one, when accounting for IU, worry was no longer significantly associated with PTSS. This suggests that worry may be an important regulatory strategy in the context of PTSS only among individuals with high levels of IU. This possibility is supported by Fergus and Wu (2010), who suggested that worry might be particularly relevant to anxiety symptoms in the context of certain dysfunctional beliefs [e.g., perfectionism/certainty, which is analogous to IU (Gentes and Ruscio 2011)]. Moreover, it has been suggested that the purpose of hypervigilance (a hallmark symptom of PTSD) is to

eliminate danger by eliminating uncertainty; that is, by preparing for possible catastrophic events, one may perceive oneself as less likely to be caught off guard should such an event occur (Smith 2007). Although IU is broadly relevant to PTSS (Smith 2007; White and Gumley 2009), it seems likely that relations between IU and posttraumatic stress hyperarousal may be particularly strong.

Present Study

This study examined worry, IU, and PTSS, first using zero-order correlations. Although we expected that worry and IU would be significantly positively correlated with all PTSS clusters, we expected worry and IU to be uniquely related with the hyperarousal cluster. We predicted this unique association based on the proposal that the purpose of hypervigilance is to eliminate danger by eliminating uncertainty, and evidence that chronic worry is associated with higher levels of arousal (Thayer et al. 1996). We also examined under what conditions worry relates to PTSS. Based on (a) the above theoretical rationale, (b) Boelen's (2010) findings which suggest that worry in the absence of IU is largely unrelated to PTSS, and (c) previous evidence that the interactive effect of worry and IU is meaningful (Fergus and Wu 2010), we examined IU as a moderator of the relationship between worry and PTSS. Considering the literature, we predicted that the relationship between worry and PTSS would be significantly stronger among those with higher IU. Similarly, and consistent with the above rationale, we predicted that the relationship between worry and hyperarousal symptoms would be significantly stronger among those with higher IU. We had no theoretical basis for predicting the interactive effect of IU and worry on the avoidance and reexperiencing symptom clusters, so no a priori hypothesis was made regarding these exploratory analyses.

Method

Participants and Procedure

Participants were undergraduates at a US university who completed a battery of questionnaires assessing trauma history, PTSS, worry, and IU in exchange for partial course credit. The 89 participants (74 % of a screening sample) who endorsed experiencing a traumatic event (*DSM-IV* PTSD Criteria A1 and A2; APA 2000) were included.[1] The sample was 55 % female, had an average age of 19.1 years ($SD = 1.2$), and was 42 % Black/African-American (35 % White/Caucasian; 12 % Hispanic/Latino; 5 % Asian; 3 % Multi-racial; 1 % Native American; 2 % did not respond). This study was approved by the University's institutional review board; written informed consent was obtained from all participants prior to data collection.

Measures

Demographics

Age, sex, and race/ethnicity were evaluated as potential covariates for planned analyses. Race/ethnicity was assessed according to the National Institutes of Health policy on reporting race (five categories plus "other") and ethnicity (Hispanic or Latina) data. Given sample size considerations, race/ethnicity was collapsed into a single dummy-coded variable (coded as White and Non-Hispanic [$n = 31$, 35 %] versus all others [$n = 56$, 63 %]).

Traumatic Life Events Questionnaire (TLEQ)

The TLEQ (Kubany et al. 2000) assesses exposure to 22 potentially traumatic events (e.g., assault, sexual abuse) consistent with *DSM-IV* PTSD Criterion A (i.e., A1 [trauma exposure] and A2 [fear, helplessness, or horror]). From the events reported, participants identify the most distressing. The TLEQ has demonstrated good psychometric properties, including high retest reliability and convergent validity with other common measures of trauma, and has been used in a range of populations (Kubany et al. 2000).

PTSD Checklist-Civilian Version (PCL-C)

The PCL-C (Weathers et al. 1991) is a 17-item questionnaire assessing *DSM-IV* PTSD Criteria B, C, and D in a civilian population. Participants rate (1 = *not at all* to 5 = *extremely*) the extent to which they experienced each symptom (past month) in relation to the traumatic event identified as most distressing on the TLEQ. The PCL-C has demonstrated good psychometric properties, including high internal consistency and retest reliability (Ruggiero et al. 2003), and convergent validity with other common PTSD symptom measures (Weathers et al. 2001). These properties have been validated in multiple trauma populations, including motor vehicle accident survivors and sexual

[1] Criterion A2 has limited clinical utility and is the topic of debate (Bovin and Marx 2011; Kilpatrick et al. 2009; Kubany et al. 2010). In fact, its exclusion from the *DSM-5* PTSD diagnostic criteria has been strongly encouraged (Friedman et al. 2011). As such, we also ran all regression models with the larger sample of participants who endorsed a potentially traumatic event ($N = 106$; i.e., Criterion A1); that is, participants did not need to also endorse Criterion A2. For this larger sample, the interaction and follow-up simple effects were unchanged; statistically significant findings remained significant and nonsignificant findings remained nonsignificant.

assault victims (Blanchard et al. 1996; Weathers et al. 1993). Consistent with evidence suggesting that PTSD is not a discrete clinical syndrome, but rather a dimensional construct (e.g., Forbes et al. 2005; Ruscio et al. 2002), we summed the PCL-C items to create both a total score and individual symptom cluster scores, for use as continuous variables. In the present sample, Cronbach's coefficient alpha for the PCL-C total score was .92.

Penn State Worry Questionnaire (PSWQ)

The PSWQ (Meyer et al. 1990) uses 16 items to assess trait worry. Participants report the degree to which each item is characteristic of them on a 5-point scale (1 = *not at all typical* to 5 = *very much typical*). The PSWQ has demonstrated good psychometric properties, including internal consistency and retest reliability (Meyer et al. 1990), and convergent validity with other worry measures (Davey 1993). In the present sample, Cronbach's coefficient alpha for the PSWQ total score was .91.

Intolerance of Uncertainty Scale-12 Item Version (IUS-12)

The IUS-12 (Carleton et al. 2007) is a 12-item questionnaire that assesses the degree to which one has difficulty accepting that negative events may occur and avoids ambiguous situations using a 5-point scale (1 = *not at all characteristic of me* to 5 = *entirely characteristic of me*). The IUS-12 is a revision of the IUS-27 (Freeston et al. 1994); the two versions correlate .96, but the revision provides better goodness-of-fit indices via confirmatory factor analysis (Carleton et al. 2007). The IUS-12 has demonstrated good psychometric properties in both clinical and nonclinical samples (Khawaja and Yu 2010), including internal consistency and convergent validity with associated constructs (worry, depression, anxiety). In the present sample, Cronbach's coefficient alpha for the IUS-12 was .89.

Results

Preliminary Analysis

Descriptive statistics for the study variables are presented in Table 1. Consistent with prior investigations, worry, IU, and PTSS all were positively correlated. None of the demographic variables exhibited significant correlations with the variables of interest.

Trauma and PTSS Descriptives

On average, participants reported experiencing approximately three traumatic events (Criteria A1 and A2; M = 2.9, SD = 2.4). The modal event identified as most distressing (Table 2) was the sudden, unexpected death of a loved one (n = 37; 42 %). However, even among this subgroup, an average of three traumatic events was reported (M = 3.0, SD = 2.2).

Considerable variability in PTSS was observed (M = 32.3, SD = 12.6, range = 17–74). The lowest reported scores indicated an absence of PTSS; the highest scores suggested the presence of PTSD (Blanchard et al. 1996). More specifically, 31 (35 %) met the PCL-C cut-score of 34 used to screen for PTSD in primary care settings (Bliese et al. 2008), and 18 (20 %) met the cut-score of 44 for efficiency in diagnosing PTSD (Blanchard et al. 1996). At the individual symptom level, scored on a scale of 0–17 possible PTSD symptoms using Blanchard et al.'s recommendations, the average total was 3.6 (SD = 3.8), with the following PTSS cluster averages: reexperiencing = 1.0 (SD = 1.3), avoidance = 1.2 (SD = 1.3), and hyperarousal = 1.3 (SD = 1.6). Moreover, 31 (35 %) met criteria for "partial PTSD" (Schnurr et al. 1993), reporting at least one symptom from each PTSD symptom cluster, and 15 (17 %) met full *DSM* PTSD Criteria B, C, and D (i.e., one or more symptoms of reexperiencing, three or more symptoms of avoidance, and two or more symptoms of hyperarousal).[2] Overall, there was considerable variability in PTSS, with some scores reaching clinical relevance.[3]

Worry, IU, and Posttraumatic Stress Symptom Clusters

To examine whether worry and IU related more strongly to hyperarousal symptoms than to either reexperiencing or avoidance symptoms, the strength of correlations was compared (see Meng et al. 1992, test for dependent correlations). Both worry (z-statistics ranged from 0.41 to 1.58, *ns*) and IU (z-statistics ranged from 0.54 to 1.03, *ns*)

[2] Among the 15 (17%) participants who met *DSM* PTSD Criteria B, C, and D (i.e., 1+ symptom of reexperiencing, 3+ symptoms of avoidance, and 2+ symptoms of hyperarousal), the IUS-12 total score (M = 31.21, SD = 8.96) was lower than in other anxiety disorder samples, including social anxiety (M = 41.65, SD = 10.23), panic (M = 37.01, SD = 12.45), generalized anxiety (M = 40.38, SD = 11.26), and obsessive–compulsive (M = 40.78, SD = 10.71; Carleton et al., 2012). The small size and student nature from which this subset was drawn should be taken into account when considering the generalizability of this finding to individuals with PTSD.

[3] To ensure that the observed interaction effects were not due to associations among IU, worry, general anxiety, or depressed mood rather than specific to posttraumatic stress, we ran all regression models in 46 participants who endorsed at least moderate levels of reexperiencing symptoms. That is, all participants met Schnurr et al.'s (1993) criteria for "partial PTSD" in reference to the reexperiencing symptom cluster. The interaction and follow-up simple effects were unchanged; statistically significant associations remained significant and nonsignificant findings remained nonsignificant.

Table 1 Descriptive statistics and correlations

Variables	1	2	3	4	5	6	7	8	9
1. Age (years)	–								
2. Sex	−.10	–							
3. Race	.10	−.10	–						
4. IUS-12	.08	−.01	−.08	.89					
5. PSWQ	.07	.15	.13	.66***	.91				
6. PCL total score	.09	.06	.02	.40***	.42***	.92			
7. PCL reexperiencing	.04	.10	−.10	.31**	.35***	.89***	–		
8. PCL avoidance	.01	.05	.00	.35***	.32**	.89***	.73***	–	
9. PCL hyperarousal	.17	.03	.12	.39***	.45***	.88***	.66***	.66***	–
M	19.13	1.55	.36	27.42	47.83	32.31	9.74	12.35	10.23
SD	1.22	.50	.48	9.06	12.88	12.55	4.39	4.62	5.13
Minimum	18	1	0	12	22	17	5	7	5
Maximum	24	2	1	53	78	74	24	25	25
N	88	89	87	89	89	89	89	89	89

$N = 89$. Coefficient alphas (where appropriate) are on the diagonal. Sex = (1 = Male, 2 = Female); Race = (0 = other/1 = non-Hispanic White)

IUS-12 intolerance of uncertainty scale (12-item version), *PSWQ* Penn State Worry Questionnaire, *PCL* posttraumatic stress disorder checklist-civilian version

** $p < .01$; *** $p < .001$

Table 2 Frequency of most distressing traumatic events

Traumatic event	Frequency of endorsement
Sudden unexpected death of loved one	37 (41.6 %)
Loved one survived a life threatening illness	11 (12.4 %)
Witnessed family violence in childhood	10 (11.2 %)
Sexual abuse in childhood	6 (6.7 %)
Motor vehicle accident	4 (4.5 %)
Physical abuse in childhood	3 (3.4 %)
Assaulted by a stranger	3 (3.4 %)
Survived a life threatening illness	3 (3.4 %)
Abortion	2 (2.2 %)
Victim of intimate partner violence	2 (2.2 %)
Physically threatened	2 (2.2 %)
Accident unrelated to motor vehicle	2 (2.2 %)
Sexual assault in adulthood (after age 18)	1 (1.1 %)
Unwanted/uninvited sexual attention	1 (1.1 %)
Miscarriage	1 (1.1 %)
Natural disaster	1 (1.1 %)

$N = 89$. Participant endorsement of the most distressing traumatic event that they have experienced in their lifetime (Criterion A1 [trauma exposure] and A2 [fear, helplessness, or horror] for PTSD as specified in *DSM-IV-TR*)

shared statistically equivalent zero-order correlations with the PTSS clusters.

Regarding partial correlations, after controlling for hyperarousal, neither reexperiencing nor avoidance correlated significantly with worry (partial *r*s = .07 and −.01, respectively, *ns*) or IU (partial *r*s = .01 and −.10, respectively, *ns*). In contrast, when controlling for reexperiencing and avoidance, both worry and IU remained significantly associated with hyperarousal (partial $r = .29$, $p < .01$ and partial $r = .22$, $p < .05$, respectively).

Regressions

Hierarchical regressions examined the interactive effect of worry and IU to predict PTSS. Regression assumptions (linearity, independence, homoscedasticity, normality of residuals; see Cohen et al. 2003) were met for all models. Consistent with Aiken and West (1991), predictor variables were mean centered and an interaction term was calculated as the product of the two centered predictor variables of interest (IUS-12 and PSWQ). In the first step, IU (mean centered IUS-12 total score) and worry (mean centered PSWQ total score) served as predictor variables; PTSS (PCL-C total score) was the outcome variable. In the second step, the interaction term was entered as a predictor variable. This sequence was repeated with each PTSS cluster serving as an outcome variable.

Predicting PTSS

There was no significant main effect of IU predicting PTSS (Table 3). There was a main effect of trait worry, with higher worry predicting higher PTSS scores ($p < .05$). In the second step, the IU x worry interaction significantly

Table 3 Regression analysis with posttraumatic stress symptoms as the outcome variable

Predictor	PCL total score			PCL reexperiencing			PCL avoidance			PCL hyperarousal		
	ΔR^2	Step 1 β	Step 2 β	ΔR^2	Step 1 β	Step 2 β	ΔR^2	Step 1 β	Step 2 β	ΔR^2	Step 1 β	Step 2 β
Step 1	.20***			.13**			.13**			.22***		
IUS		.21	.15		.14	.10		.24	.22		.17	.08
PSWQ		.29*	.26*		.26	.24		.16	.15		.33**	.28*
Step 2	.04*			.01			.01			.11***		
IUS × PSWQ			.21*			.12			.08			.35***

$N = 89$ with trauma experiences (Criterion A1 and A2)

PCL posttraumatic stress disorder checklist-civilian version, *IUS* intolerance of uncertainty scale (12-item version), *PSWQ* Penn State Worry Questionnaire

* $p < .05$; ** $p < .01$; *** $p < .001$

predicted PTSS ($p < .05$) with a small to medium effect size (Cohen's $f^2 = .06$; Aiken and West 1991).

To further examine the interaction, two simple regression equations were constructed in which the relationship between worry and PTSS was tested at both high (+1 SD) and low (−1 SD) levels of IU (simple slopes analysis; Aiken and West 1991). Results revealed a significant positive association between worry and PTSS for participants who reported high IU ($B = .47$, $\beta = .48$, $p < .01$), with participants both high in IU and high in worry reporting greater PTSS than those high in IU and low in worry. No association was found for those who reported low IU (Fig. 1).

Predicting Posttraumatic Stress Symptom Cluster Scores

IU was not a significant predictor of any PTSS cluster score. Worry did not significantly predict reexperiencing or avoidance; however, worry significantly predicted hyperarousal ($p < .01$) in the first step of the model (Table 3). This main effect remained significant when the interaction term was added. The IU x worry interaction significantly predicted hyperarousal ($p < .001$) with a medium effect size (Cohen's $f^2 = .16$), but not reexperiencing or avoidance symptoms.

Again, the interaction term was probed using simple slopes analysis and results mirrored those from the interaction effect found in the first model. There was a significant positive association between worry and hyperarousal for participants who reported high IU ($B = .26$, $\beta = .65$, $p < .001$); participants high in IU and high in worry reported greater hyperarousal symptoms than participants high in IU and low in worry. No association was found between worry and hyperarousal symptoms for participants who reported low IU (Fig. 2).

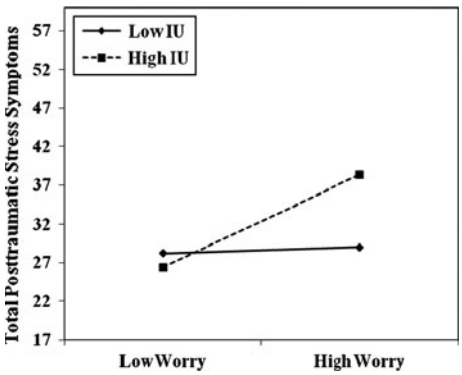

Fig. 1 Interaction effect (worry × intolerance of uncertainty [IU]) was a significant predictor of posttraumatic stress symptoms (PTSS), $\beta = .21$, $p < .05$. Simple slopes analysis revealed that participants high in IU and high in worry reported greater PTSS than participants high in IU and low in worry. There was no significant association between worry and PTSS among participants reporting lower IU. Total PTSS was measured via the posttraumatic stress disorder checklist-civilian version (PCL-C). A score of 17 on the PCL-C is the lowest possible value

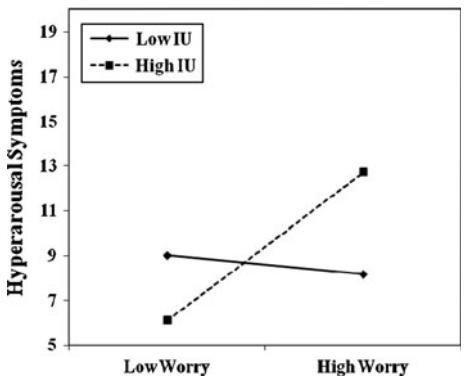

Fig. 2 Interaction effect (worry × intolerance of uncertainty [IU]) was a significant predictor of hyperarousal symptoms, $\beta = .35$, $p < .001$. Simple slopes analysis revealed that participants high in IU and high in worry reported greater hyperarousal symptoms than participants high in IU and low in worry. There was no significant association between worry and hyperarousal symptoms among participants reporting lower IU. Hyperarousal symptoms were measured via the posttraumatic stress disorder checklist-civilian version (PCL-C). A score of 5 on the PCL-C hyperarousal cluster is the lowest possible value

Discussion

This study examined associations among worry, IU, and PTSS. Consistent with previous research, worry and IU both positively correlated with PTSS. Among the PTSS clusters, partial correlations suggest that symptoms of hyperarousal may be driving the associations between PTSS and both worry and IU, as hyperarousal was the only symptom cluster with which they shared unique associations. Further, we found support for our hypothesis that the interactive effect between worry and IU is important for understanding PTSS. The pattern of this interactive effect revealed a significant positive association between worry and PTSS at high, but not low, levels of IU. Worry may be an important individual difference factor in the development and maintenance of PTSS only for those who are particularly intolerant of uncertainty.

These findings may be conceptualized as resulting from the impact of IU and worry on finite cognitive resources. Specifically, greater IU is thought to increase one's sense of threat. As perceived threat increases, so does the amount of attention allocated to threat-related stimuli. Similarly, worry is thought to increase one's level of attention to perceived threat. With the majority of executive attentional resources allocated toward potential threat, higher-order cognitive resources are unavailable to process trauma information in a flexible and integrative manner, thus maintaining PTSS. Further, it seems likely that sense of threat would be significantly lower among individuals who have a greater tolerance for uncertainty, as these individuals likely find the ambiguity surrounding traumatic events less threatening compared to individuals with higher levels of IU. Consequently, individuals who are tolerant of uncertainty may direct less attention to ambiguous information, as well as experience lower perceived threat and hypervigilance; for them, worry alone may not absorb enough top-down cognitive resources to preclude emotional processing, thus decreasing their risk of PTSS following a trauma.

The present results suggest that the interactive effect of IU and worry on hyperarousal symptoms may exacerbate overall PTSS. When examining each symptom cluster separately, the interactive effect only emerged as relevant to hyperarousal. This effect was consistent with the one described above, with a positive association between worry and hyperarousal observed for individuals with high, but not low, IU. The specificity of this effect to the hyperarousal symptom cluster is consistent with the proposal that the "purpose" of hypervigilance is to eliminate danger by eliminating uncertainty, as well as with evidence that chronic worry is associated with consistently higher levels of arousal (Newman and Llera 2011).

Newman and Llera's (2011) contrast-avoidance model suggests that chronic worry serves to create a high steady state of arousal and negative affect. Much like the symptoms of emotional numbing found in PTSD, restricted affect is experienced in this state. The applicability of Newman and Llera's theory to PTSS is further supported by research showing that hyperarousal symptoms are associated with emotional numbing beyond the effects of reexperiencing symptoms, depression (Palyo et al. 2008), and experiential avoidance (Tull and Roemer 2003). Among the symptom clusters, when examined prospectively, hyperarousal has the greatest impact on recovering from PTSD. Individuals who report hyperarousal symptoms as most bothersome—compared to individuals who report reexperiencing or avoidance as most bothersome—show significantly less improvement and a more chronic course in terms of overall PTSS assessed longitudinally (Schell et al. 2004). Among the symptom clusters, hyperarousal is the best predictor of the other symptom clusters at subsequent time points, even out predicting the autoregressive effects of avoidance and reexperiencing (Marshall et al. 2006; Schell et al. 2004). Moreover, physiological indicators of hyperarousal (e.g., elevated heart rate) measured shortly after a traumatic experience predicted the development of PTSD (Bryant et al. 2000). Taken together, empirical findings suggest that among PTSS, hyperarousal symptoms may determine (a) the initial progression of posttraumatic reactions into clinically significant trauma-related pathology, and (b) the course of PTSD symptom expression. As such, gaining greater insight into the role of worry, IU, and their interactive effect in relation to hyperarousal in future studies might be particularly informative for furthering our understanding of PTSD.

Study limitations must be acknowledged. Perhaps the most significant limitation is the use of a student sample, the majority of whom may be assumed to function at a higher level than individuals with PTSD in a clinical setting. In addition, the amount of time elapsed since each participant's Criterion A event (and more specifically Criterion E: symptom duration of at least one month) and Criterion F (the distress or impairment qualifier) were not assessed. Therefore, caution is warranted in generalizing these findings to a clinical population. However, it is important to note that participants reported experiencing an average of three traumatic events in their lifetimes. It is also worth noting that participants reported a wide array of trauma types, including the sudden, unexpected death of a loved one and a loved one surviving a life-threatening illness. In fact, the sudden and unexpected death of a loved one was identified as the most distressing trauma experience by 37 participants (42 %). Although this event may not be viewed by some as reflective of "classic" PTSD (e.g., physical assault, combat), even among this subgroup, an average of approximately three traumatic events was reported ($M = 3.0$, $SD = 2.2$), thus increasing confidence

in the generalizability of the present results. Moreover, there was considerable variability in PTSS, as a substantial proportion reported appreciable posttraumatic stress symptomatology. Approximately one-third of the sample met the criteria for "partial PTSD" (Schnurr et al. 1993) as well as the threshold recommended to screen for PTSD in primary care settings (Bliese et al. 2008).

Four additional caveats are worth considering. First, the sample included only individuals who had experienced a traumatic event as defined by *DSM*. In fact, the majority of college students report a traumatic event, with rates ranging from 66 to 82 % in large samples consisting primarily of freshmen (Bardeen et al. 2012; Read et al. 2011). When participants who met Criterion A1 but not A2 were included in analyses, results were nearly identical. Again, replication using well-defined clinical samples is needed for ensuring generalization to that population. Second, $N = 89$ is a relatively modest sample size for a correlational study. Nonetheless, the resultant data conformed to the conceptual hypotheses via a meaningful pattern of statistically significant results. We provided estimates of effect sizes to further demonstrate the potential value in these preliminary data, but further work is needed to provide additional support for the robustness and meaningfulness of our observed interactive effect. A third limitation is that the cross-sectional nature of our study precluded conclusions regarding causation. The use of experimental and longitudinal designs in future studies may help address the direction of relations among IU, worry, and PTSS. Fourth, our fixed order self-report method of assessment may have resulted in inflation of the magnitude of relations among the study variables. However, correlated measurement error—which might be expected with monomethod assessment—does not appear to produce spurious interactions; rather, it may attenuate them (Evans 1985). This limitation is therefore not likely responsible for the observed significant interaction effects.

With these limitations in mind, the present study suggests a specific risk profile for the experience of high PTSS following a traumatic event—namely, high worry in conjunction with high IU. Among the PTSS clusters, this risk profile shows specificity for hyperarousal. Given evidence which suggests a causal role of hyperarousal in the etiology of PTSD (Marshall et al. 2006; Schell et al. 2004), identification of a risk profile for the development of hyperarousal symptoms may aid in the creation of community programs or interventions in the acute aftermath of a traumatic event which target individuals with this specific profile. Treatment resources may be most efficiently distributed following large-scale traumatic events by identifying trauma survivors with high state levels of worry, who also exhibit high IU. Because these individuals appear to be more likely to exhibit high arousal, they may be at higher risk for the development of chronic posttraumatic stress symptomatology. Because emotional processing—a necessary precondition for fear extinction—is unlikely to occur when one's level of arousal is too high or too low (Foa and Kozak 1986), interventions targeting IU might aid in mitigating the effects of worry on one's arousal level and thus help to facilitate adequate emotional processing. The importance of targeting IU before completing exposures has been advocated by Grayson (2010); however, this practice is not typical within standard exposure-based interventions for PTSD. Further elucidating the IU-PTSS relation might thus ultimately lead to the use of IU intervention strategies (Dugas and Robichaud 2007; Grayson 2010) for improving upon the effectiveness of state-of-the-art PTSD interventions, such as prolonged exposure and cognitive processing therapy.

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