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Structural Analysis of the Trauma Symptom Inventory–2

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ABSTRACT
The Trauma Symptom Inventory (TSI; Briere, 1995), a measure of the psychological effects of trauma and other adverse events, was recently expanded and updated (TSI–2; Briere, 2011). This study evaluated 4 competing models of TSI–2 dimensionality and determined the predictive validity of the best fitting solution. Data were collected from 679 adults in the general population. Confirmatory factor analysis indicated that a 4-factor solution best fit the data. All 4 factors of the final model were significant predictors of exposure to trauma or some other very upsetting event, especially posttraumatic stress. Additional research is indicated to further probe the characteristics of the TSI–2, including its dimensionality in other groups.

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Until recently, the psychological effects of trauma exposure have been viewed as relatively circumscribed, most typically involving the symptoms of posttraumatic stress disorder (PTSD) and its frequent precursor, acute stress disorder (ASD; American Psychiatric Association, 2013). These disorders are characterized by reexperiencing, avoidance responses, autonomic hyperarousal and reactivity, and negative alterations in mood and cognitions, as well as, in many cases, dissociation. Also present may be comorbid symptoms or disorders, such as anxiety, depression, and substance abuse (American Psychiatric Association, 2013).

As research has advanced, however, a number of other symptoms and problems associated with exposure to highly adverse events also have been identified, including somatization, suicidality, sexual difficulties, affect dysregulation, identity problems, attachment disturbance, relationship difficulties, and various dysfunctional behaviors (see reviews by Courtois & Ford, 2009; Godbout & Briere, 2012; van der Kolk, Roth, Pelcovitz, Sunday, & Spinazzola, 2005). Unfortunately, few standardized tests have been developed to evaluate this broader range of symptoms and problems. Instead, clinical

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assessment of trauma-relevant symptomatology typically involves a battery of more narrowly defined tests, nonnormed trauma measures, or a clinical interview (Briere & Spinazzola, 2009).

One alternative to the use of a battery of specifically focused tests has been the Trauma Symptom Inventory (TSI; Briere, 1995), a standardized, validated measure that addresses a variety of outcomes and is often used in the assessment of complex trauma effects (Arbisi, Erbes, Polusny, & Nelson, 2010; Elhai, Gray, Kashdan, & Franklin, 2005; Fernandez, 2001; McDevitt-Murphy, Weathers, & Adkins, 2005; Snyder, Elhai, North, & Heaney, 2009). The growing age of the TSI, however, suggested the need for item and scale updates and renorming on the current general population. The resultant Trauma Symptom Inventory–2 (TSI–2; Briere, 2011) evaluates all of the original TSI domains but also includes additional symptom clusters, thereby permitting a more complete evaluation of trauma- or adversity-related outcomes. The TSI–2 consists of 136 items and has 12 clinical scales of 10 items each, as presented in Table 1. Nine scales are updated from the original TSI, whereas three (Somatic Preoccupation, Suicidality, and Insecure Attachment) are new.

Table 1. Trauma Symptom Inventory–2 Scales and Subscales.

Scale	Subscales
Anxiety (AA)	AA-Anxiety (AA-ANX)
	AA-Hyperarousal (AA-H)[a]
Intrusive Experiences (IE)	
Defensive Avoidance (DA)	
Dissociation (DIS)	
Insecure Attachment (IA)[a]	Relational Avoidance (IA-RA)[a]
	Rejection Sensitivity (IA-RS)[a]
Impaired Self-Reference (ISR)	Reduced Self-Awareness (ISR-RSA)[a]
	Other-Directedness (ISR-OD)[a]
Depression (DEP)	
Suicidality (SUI)[a]	Suicidal Behavior (SUI-SB)[a]
	Suicidal Ideation (SUI-SI)[a]
Sexual Disturbance (SXD)	Dysfunctional Sexual Behavior (SXD-DSB)[a]
	Sexual Concerns (SXD-SC)[a]
Tension Reduction Behavior (TRB)	
Anger (ANG)	
Somatic Preoccupation (SOM)[a]	General (SOM-GEN)[a]
	Pain (SOM-P)[a]

[a]Indicates scales or subscales new to the Trauma Symptom Inventory–2.

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In addition to its use with trauma-exposed populations, the TSI–2 is also applied to individuals for whom a trauma history has not been ascertained or whose history of adverse events is not technically considered traumatic according to the *Diagnostic and Statistical Manual of Mental Disorders* (5th ed. [*DSM–5*]; American Psychiatric Association, 2013) PTSD and ASD Criterion A (i.e., actual or threatened death, serious injury, or sexual violence). Such events, which include psychological maltreatment, childhood attachment disturbance, and severe emotional loss, might nevertheless produce symptoms associated with posttraumatic or acute stress (Carlson, Smith, & Dalenberg, 2013; Long et al., 2008). In addition, not all trauma impacts involve symptoms of PTSD or ASD and, thus, their correspondence to Criterion A is not directly relevant. As a result, the TSI–2 (as with the original TSI) was normed and standardized on the general population without reference to a specific (*DSM*-level) trauma history.

Because the TSI–2 is a relatively new measure, its psychometric properties are less established than those of the original TSI. In particular, the underlying factor structure of this measure has not been fully explicated. The TSI–2 manual briefly describes a confirmatory factor analysis (CFA) of the TSI–2 in the standardization study; however the analyses employed in that context included the respecification of correlated error terms, partially based on modification indexes, an approach we ultimately discarded over concerns about possible capitalization on error variance (e.g., Silvia & MacCallum, 1988). In addition, the structural analysis of the TSI–2 reported in the manual did not examine the relative validity of other competing structural models suggested by other studies. By providing a detailed test of the factor structure of the TSI–2, we aimed to not only examine the factorial validity of this measure, but also to evaluate alternative hypotheses regarding the relationships between the symptom domains tapped by TSI–2 scales and subscales.

Potential models of TSI –2 scale and subscale structure

We considered four potential models of TSI–2 dimensionality, of which Model 4 was hypothesized to be the best fitting. Each of these models was based on empirical and theoretical grounds.

Model 1: Single factor

This model suggests a generalized distress response. Support for this construct comes from studies showing strong correlations among trauma symptom scales and measures of general distress and negative emotionality (e.g., Shapinsky, Rapport, Henderson, & Axelrod, 2005), as well as models

identifying a general dysphoria factor (Simms, Watson, & Doebbelling, 2002). The TSI–2 test manual indicates significant relationships among all TSI–2 scales and subscales, and previous results revealed strong correlations between the original TSI factors (Briere, 1995). This suggests the possibility of a single-factor model in which Depression (DEP), Dissociation (DIS), Anger (ANG), Defensive Avoidance (DA), Intrusive Experiences (IE), Tension Reduction Behavior (TRB), and the subscales of Insecure Attachment (IA), Impaired Self-Reference (ISR), Anxious Arousal (AA), Sexual Disturbance (SXD), Suicidality (SUI), and Somatic Preoccupations (SOM) all load on a single latent variable.

Model 2: Original two TSI factors

Data were presented in the original TSI manual regarding an alternative two-factor model, derived through exploratory factor analysis, involving generalized trauma/distress and self factors. Although this solution was rejected because some aspects were inconsistent with trauma theory, its fit characteristics were good enough to warrant its evaluation in the TSI–2. In addition, in a sample of 221 treatment-seeking veterans, Snyder et al. (2009) found this two-factor model to be a well-fitting factor solution for the TSI. The best approximation of this model in the TSI–2 involved assigning ANG; TRB; and the subscales of ISR, IA, SXD, and SUI to a self factor, and ANG; DEP; DIS; DA; IE; and the subscales of ISR, AA, and SOM to a trauma/dysphoria factor.

Model 3: Replication of the original three TSI factors

The model of the original TSI was based on a theoretically driven CFA, involving three correlated latent factors: self, trauma, and dysphoria. In agreement with the good fit indexes reported for this model in the TSI manual, Snyder et al. (2009) obtained similar results in a sample of war veterans. This model was approximated in the TSI–2 by assigning TRB; ANG; and the subscales of ISR, SXD, and IA to a self factor; IE, DA, DIS, and the subscales of ISR and SOM to a trauma factor; and ANG, DEP, and the subscales of AA and SUI to a dysphoria factor.

Model 4: New three factors

Based on the confirmatory factor structure of the original TSI and the expected contribution of new TSI–2 scales and subscales, we hypothesized that a new three-factor model would best fit the data. The original TSI self factor was approximated in this model (now called self-disturbance), but it was restricted to a more precise self/identity factor that included the ISR subscales, DEP, and IA subscales, and excluded anger, sexual disturbance,

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and tension-reduction behavior. The newly named posttraumatic stress factor replicated the original trauma factor, but also included the new AA and SOM subscales. We considered SOM as a potential indicator of posttraumatic stress based on research suggesting that somatization can be a bodily reflection or component of PTSD (e.g., Andreski, Chilcoat, & Breslau, 1998). Finally, a new externalization factor was proposed, representing dysfunctional, outwardly directed behaviors that are commonly cited in the clinical literature and have been associated with trauma exposure (e.g., Briere, Hodges, & Godbout, 2010) or a history of insecure attachment (e.g., Scott, Levy, & Pincus, 2009). Indicators of this factor in the TSI–2 were TRB, the SXD subscales, the newly added SUI subscales, and ANG.

Model 5: New four factors

Although we hypothesized that somatization would load on Posttraumatic Stress in Model 4, it seemed possible that the SOM subscales of the TSI–2 might form their own distinct factor, reflecting a particular tendency to experience somatic distress in response to trauma or other adverse experiences. For this reason, a four-factor model was considered, involving posttraumatic stress, externalization, self-disturbance, and somatic preoccupation. By creating a distinct, separate somatization factor, this model also allowed a more traditional representation of the posttraumatic stress factor.

Method

Participants

This study was conducted using archival data from the TSI–2 (Briere, 2011) normative sample, with permission from the test publisher, Psychological Assessment Resources (PAR). This sample was stratified to be representative of the U.S. population for individuals between 18 and 90 years old with regard to age, gender, race and ethnicity, educational attainment, and geographic region. Individuals were excluded from this sample if they were (a) incarcerated, (b) currently residing in an inpatient medical or psychiatric facility, (c) under medical care for schizophrenia or some other psychotic disorder, (d) suffering from uncorrected vision or hearing loss, (e) unable to comprehend English or read at the third-grade level, or (f) otherwise unable to provide informed consent.

The final sample consisted of 367 women and 312 men. Mean age was 53.4 years (*SD* = 18.3, range = 18–87). The majority of participants were White (73%), with 11% African American; 9% Latino; and 7% reporting Asian, American Indian, or "other" ethnicity. Of all participants, 15% had not graduated from high school, 32% graduated high school only, 27% had

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some college education, and 26% had at least a 4-year college or university degree. The most represented states were Florida (8%), California (8%), Texas (8%), Pennsylvania (6%), Illinois (6%), and New York (5%).

Measurement

Trauma symptom inventory–2

Responses on the TSI–2 (Briere, 2011) reflect the frequency of self-reported symptoms over the previous 6 months, rated on a scale of 0 (*never*) to 3 (*often*), without reference to any specific trauma. As noted earlier, the TSI–2 consists of 12 clinical scales, each composed of 10 items. Six of these scales are further divided into two 5-item subscales. These subscales were used in the analyses instead of the overall scales to increase the specificity of each construct. Respondents were characterized as having been exposed to an adverse experience in this study based on their yes–no response to the question, "At any time in your life, have you experienced a trauma or a very upsetting event?"

Procedure

Respondents were anonymously recruited by e-mail through a national survey sampling company employed by PAR, after which participants' responses to the TSI–2 were collected via the Web. The specific number of individuals recruited for this study is unknown to the test publisher, and, thus, the response rate cannot be calculated. PAR did not have access to names or other identifying information, and the survey company did not have access to the responses. All responses were kept anonymous and confidential. The first 679 individuals who met the specified criteria for inclusion and fit the specific demographic matrix for representativeness of the general population participated in the standardization process and constituted the sample used in this study. The University of Southern California Institutional Review Board approved the analysis of the deidentified data from the TSI–2 normative sample.

Analytic strategy

The structure of the TSI–2 was tested with CFA, using Bentler's (2005) EQS 6.1 multivariate software. CFA formally tests how well the data fit a hypothesized factor structure. In contrast to exploratory factor analysis, which is primarily a data-driven approach, the goal of CFA is to test whether a data set reflects an a priori model. CFA requires prior specification of one or more competing models, postulating the number of factors and patterns of factor loadings of the measured variables on specified factors (Fabrigar, Wegener, MacCallum, & Strahan, 1999).

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Because many symptoms tapped by the TSI–2 (e.g., suicidality, dysfunctional sexual behavior) are unlikely to be normally distributed, the robust estimation method was used with Satorra and Bentler's (1994) scaling corrections, allowing for the calculation of the Satorra–Bentler scaled chi-square value and a corrected fit index. Incremental fit indexes (i.e., the nonnormed fit index [NNFI; Bentler & Bonett, 1980] and the comparative fit index [CFI; Bentler, 1988]) that are greater than .90 generally signify a good model fit. Steiger and Lind's (1980) root mean square error of approximation (RMSEA) was used to determine the error of approximation in the population and to estimate the difference between model-implied and actual variances and covariances. Values less than .08 represent reasonable errors of approximation (Hu & Bentler, 1999), and narrow confidence intervals indicate good precision of the RMSEA value in reflecting model fit in the population (MacCallum, Browne, & Sugawara, 1996). Because the chi-square test for goodness of fit is sensitive to sample size, the ratio of chi-square to degrees of freedom (χ^2/df) was used. Values between 1 and 5 generally indicate a satisfactory fit between the theoretical model and empirical data (Jöreskog & Sörbom, 1993). Finally, Akaike's information criterion (AIC; Akaike, 1987), an unbiased measurement used for model selection, was employed to rank competing models according to their AIC, with the lowest AIC reflecting the best fitting model.

To determine the relative predictive validity of the best fitting TSI–2 factors with regard to exposure to trauma or other adversity, participants' responses to the trauma or upsetting event were then entered into a discriminant function analysis. This analysis employed the TSI–2 unit-weighted factors as discriminators of exposure to trauma or another very upsetting event. Also calculated were post hoc univariate analyses of variance (ANOVAs), examining TSI–2 factor scores as a function of exposure to trauma or other very upsetting events.

Results

As presented in Table 2, CFAs indicated that factor Models 1, 2, and 3 had unacceptable indexes of fit and significant unexplained variance, in each case with CFIs and NNFIs less than .90, RMSEAs greater than .08, and chi-square

Table 2. Confirmatory Factor Analysis Model Fit Indexes in the Standardization Sample.

Model	$\chi^2(df)$	Ratio	CFI	NNFI	RMSEA [90% CI]	AIC
5: New four-factor	614.99 (123)	4.99	.91	.89	.07 [.07, .08]	368.99
4: New three-factor	718.72 (126)	5.70	.89	.87	.08 [.08, .09]	466.72
3: TSI replication	788.23 (123)	6.41	.88	.85	.09 [.08, .09]	542.27
2: Two-factor	830.67 (125)	6.65	.87	.84	.09 [.09, .10]	580.67
1: Single-factor	867.43 (129)	6.72	.87	.84	.09 [.09, .10]	609.44

Note: $N = 679$.

ratios greater than 5. Model 4 had a nearly acceptable RMSEA value (.08), but the goodness-of-fit indexes did not reach acceptable criteria (CFIs and NNFIs less than .90, and a chi-square ratio of 5.70). In contrast, Model 5, which involved the addition of a somatization factor to Model 4, was a good fit to the data on all statistical parameters (see Table 2). Further, Model 5 also had the lowest AIC of all models considered, suggesting that it was the best representation of the data as compared to the other models. Model 5 reflected trauma theory more clearly than the other models, as the posttraumatic stress factor taps a range of *DSM–5* (American Psychiatric Association, 2013) PTSD criteria, including dissociation, but does not include somatization. The standardized path coefficients for this model are presented in Figure 1. All standardized path coefficients for each latent factor indicator were significant at $p < .01$.

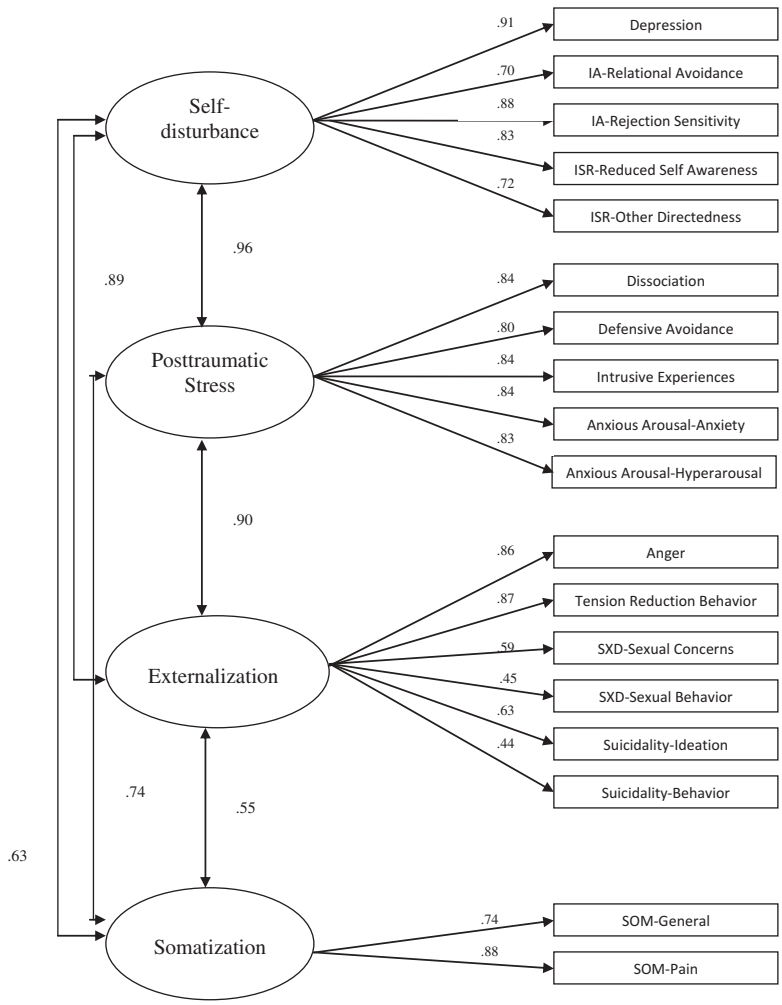

Figure 1. Results of confirmatory factor analysis of the hypothesized four-factor structure of Trauma Symptom Inventory–2. Path coefficients were all significant at $p < .001$. IA = Insecure Attachment; ISR = Impaired Self-Reference; SXD = Sexual Disturbance; SOM = Somatic Preoccupation.

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Table 3. Discriminant Function Analysis of the Relationship Between the final Trauma Symptom Inventory–2 Factors and Participant Reports of Trauma or Other Adverse Event.

Trauma Symptom Inventory–2 factor	No trauma[a] (n = 459)		Trauma (n = 220)		Discriminant function analysis		
					ANOVA		Discriminant structure
	M	*SD*	*M*	*SD*	*F*(1,677)	*p* <	*c*[b]
Self-disturbance	21.72	16.88	32.0	19.47	49.92	.001	.84
Posttraumatic stress	25.53	19.97	38.81	21.73	62.08	.001	.93
Externalization	13.76	13.10	20.95	18.09	34.59	.001	.70
Somatization	8.83	5.34	12.04	5.95	49.75	.001	.83

Note: N = 679. ANOVA = analysis of variance.
[a]Trauma or another very upsetting event. [b]Discriminant structure coefficient.

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Thirty-two percent of participants (n = 220) indicated that they had experienced a trauma or some other very upsetting event in their lives. As presented in Table 3, discriminant function analysis indicated that all four factors of Model 5 were significant predictors of this trauma or adversity variable, $\chi^2(4) = 67.79$, $p < .001$, with the discriminant structure matrix and post hoc ANOVAs suggesting greatest prediction by posttraumatic stress and least, but still significant, prediction by externalization.

Discussion

Results of this study did not support the initial hypothesis of three factors underlying the TSI–2 wherein externalization was separated from self-disturbance but included somatization as an aspect of posttraumatic stress. Instead, we found that the optimal factor solution involved four symptom dimensions: self-disturbance, posttraumatic stress, externalization, and somatization. The validation of a new somatization factor, consisting of pain symptoms and a general preoccupation with bodily concerns, is in agreement with research indicating that excessive worry about bodily dysfunction can be a sequel of exposure to adverse events (Sack, Lahmann, Jaeger, & Henningsen, 2007). However, it suggests that somatic preoccupation should not be considered a component of posttraumatic stress, but rather a relatively independent outcome of trauma and other very upsetting life experiences.

These analyses also indicate that fear of rejection, relational avoidance, self-awareness problems, and a tendency to look toward others to define reality, all of which are associated with adverse experiences (e.g., Brock, Pearlman, & Varra, 2006), might differ from externalizing behaviors (e.g., self-injury, dysfunctional sexual behavior) that are also found among survivors of major adverse events (e.g., Yates, 2004). This may be because self–other issues, such as those described in the self-disturbance factor, often

reflect interpersonal phenomena, which differ from externalization activities thought to provide distraction, numbing, or tension reduction in the service of avoiding overwhelming emotional states (Briere & Scott, 2014). However, the high correlation (r = .89) in Model 5 between self-disturbance and externalization factors suggests significant communality between these two dimensions, despite their improved fit to the data when they are divided into separate sources of variance. This covariation between self–other functioning and externalizing behaviors is often found among those thought to have undergone chronically negative childhood experiences; for example, those diagnosed with borderline personality disorder (American Psychiatric Association, 2001) or who meet the proposed criteria for developmental trauma disorder (van der Kolk & D'Andrea, 2010). Nevertheless, as indicated by the current findings, self–other issues and externalizing behaviors are generally different phenomenon and should probably be assessed independently of one another.

The posttraumatic stress factor found in Model 5 consists of the symptom clusters most characteristic of PTSD: hyperarousal, reexperiencing, and avoidance, along with generalized anxiety and dissociation (American Psychiatric Association, 2013). The presence of dissociation in this factor is in accord with research indicating that dissociation often accompanies posttraumatic stress (Carlson, Dalenberg, & McDade-Montez, 2012; DePrince, Chu, & Visvanathan, 2006), and, importantly, supports the American Psychiatric Association's (2013) *DSM–5* inclusion of a dissociative subtype of PTSD (Lanius, Brand, Vermetten, Frewen, & Spiegel, 2012). The model also agrees with other dimension reduction analyses, as well as the new *DSM–5* criterion set for PTSD, suggesting that anxiety, above and beyond autonomic hyperarousal, is a common component of posttraumatic stress (American Psychiatric Association, 2013; Armour et al., 2012).

Discriminant function analysis revealed that all four factors of Model 5 were significant predictors of exposure to trauma or another very upsetting event, especially the posttraumatic stress factor. This finding, although expected, is noteworthy given the wide net cast by the trauma and adversity variable, which asked about any "trauma" (unspecified) or "other very upsetting event" and, thus, included exposure to a range of negative phenomena. This general relationship supports the intended function of the TSI–2, which is to evaluate symptomatic response to both Criterion A and non-Criterion A events, as described in the introduction.

Limitations

The conclusions of this study should be tempered by its limitations. First, given the commonly employed stratified sampling approach used by the test publisher wherein study enrollment ceased once all demographic groups

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were representative of general population proportions, the actual response rate of participants of this study is unknown. Specifically, although the final sample was carefully stratified to match the demographics of the general population, a low participation rate could have resulted in sample bias associated with one or more unmonitored variables. Second, this study was retrospective, and, thus, participants' reports of trauma and upsetting event exposure could have been influenced or distorted by the passage of time. Third, this sampling approach did not assess the TSI–2 in individuals presenting for mental health assistance. Because help-seeking groups tend to differ from individuals in the general population, it is possible that the TSI–2 factor structure investigated here would not be replicated in clinical groups. As a result, additional research is indicated to further probe the TSI-2's psychometric characteristics, including its dimensionality in mental health clients and other groups.

Finally, although not technically a limitation, the TSI and TSI–2 were developed to evaluate a wide range of adversities (e.g., not only trauma, but early emotional neglect, psychological abuse, and experiences of loss), and, therefore, the sample in which the TSI–2 was examined was not limited to *DSM–5*-level trauma survivors, but rather included all potential participants. As a result, the factor structure tested here might or might not represent the structure of the TSI–2 among those specifically exposed to a traumatic event as described in the *DSM–5* (American Psychiatric Association, 2013).

Conclusion

In summary, the TSI–2 appears to tap a number of discrete symptom dimensions. In addition to its previously demonstrated psychometric characteristics, these results support the factorial validity of the TSI–2 and validate the use of summary factor scores in clinical and research applications of this measure. With regard to the latter group, those studying the effects of trauma, violence, maltreatment, and other adverse events may choose to employ this smaller subset of outcome dimensions as opposed to all of the scales and subscales of the TSI–2.

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