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Can Developmental Trauma disorder be distinguished from posttraumatic stress disorder? A confirmatory factor Analytic Test of Four Structural Models

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Abstract

Developmental Trauma Disorder (DTD) is a proposed child psychopathology diagnosis with emotion/somatic, attention/behavioral, and self/relational dysregulation symptoms extending beyond posttraumatic stress disorder (PTSD). Confirmatory factor analyses (CFAs) tested four structural models with structured interview data for trauma history, PTSD, and DTD with 507 children receiving mental health or pediatric care ($N=162$, 32% diagnosed with DTD; $N=176$; 35% with PTSD; $N=169$, 33% with neither). A unidimensional model with a single latent variable had unacceptable fit (RMSEA = 0.094; CFI = 0.844). Compared to a model with PTSD and DTD as correlated first-order latent variables, a multidimensional model with correlated latent variables corresponding to the PTSD and DTD symptom clusters ($Dc^2=105.62$, Ddf = 14, $p<.001$) and a hierarchical variant with correlated second order DTD and PTSD latent variables ($Dc^2=48.10$, Ddf = 6, $p<.001$) fit the data better. The non-hierarchical multidimensional model was superior to the hierarchical variant ($Dc^2=66.05$, Ddf = 8, $p<.001$). Stronger latent variable inter-correlations within PTSD and DTD domains than across domains, suggested that DTD and PTSD are distinguishable despite their inter-correlation. Exposure to family violence was the primary correlate of both the DTD and PTSD second-order latent variables. Results indicate that children's trauma-related symptoms involve six inter-correlated domains extend beyond PTSD's symptoms (i.e., re-experiencing, avoidance, arousal) to include DTD symptoms of emotional, cognitive-behavioral, and self-relational dysregulation. The inter-relationship of the DTD and PTSD latent variables suggest that DTD may constitute a component within a complex PTSD diagnosis paralleling the new adult CPTSD diagnosis.

Keywords Trauma · Developmental · PTSD · Children · Adolescents · Confirmatory factor analysis

Children who have experienced traumatic victimization (Weissman et al., 2020b) and disrupted attachment bonding with primary caregivers often are impaired by complex and severe symptoms of both affective/anxiety (internalizing) and behavioral (externalizing) disorders (Basu et al., 2020) that include, but often extend beyond, the symptoms of

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posttraumatic stress disorder (PTSD) (Kaplow et al., 2020), reactive attachment disorder (Atkinson, 2019), and disinhibited social engagement disorder (Guyon-Harris et al., 2018). Developmental Trauma Disorder (DTD) was formulated to address children's complex trauma-related symptoms that extend beyond the symptoms of PTSD (D'Andrea et al., 2012; Ford et al., 2018). DTD has four criteria. Criterion A is childhood exposure to traumatic adversity and attachment disruption.

Three symptom domains represent the remaining DTD criteria. Criterion B includes affective/somatic dysregulation symptoms, based on research showing that emotion dysregulation is a mechanism linking childhood adversity and psychopathology (Aldao et al., 2016; Beauchaine & Cicchetti, 2019; Conway et al., 2018; Heleniak et al., 2016; McLaughlin et al., 2020; Weissman et al., 2019) and evidence that children often express emotional distress indirectly through somatic complaints and somatoform symptoms (Agnafors et al., 2019). The second DTD domain (Criterion C), cognitive/behavioral dysregulation, has symptoms of cognitive/attentional preoccupation with threat (McLaughlin et al., 2020; Weissman et al., 2020a) and behavioral disinhibition/dyscontrol associated with impaired executive functions and effortful control (Beauchaine & Cicchetti, 2019; Hankin et al., 2017; Huang-Pollock et al., 2017; Santens et al., 2020; Snyder et al., 2019; Wade et al., 2020). The third DTD domain (Criterion D), relational/identity dysregulation, includes both avoidant and aggressive modes of relational engagement and social information processing (McLaughlin et al., 2020; Schweizer et al., 2020), attachment insecurity (Bryant et al., 2017), and self-devaluation and self-ideal discrepancy (Mason et al., 2019; Schweizer et al., 2020).

DTD has been tested in a field trial study conducted to examine its structure, childhood trauma antecedents, and psychiatric comorbidities, as well as the psychometric integrity of a semi-structured interview developed to assess DTD (Ford et al., 2018; Spinazzola et al., 2018; van der Kolk et al., 2019). Initial evidence from that study is consistent with the results of two surveys of practicing clinicians (DePierro et al., 2019; Ford et al., 2013), suggesting that symptoms comprising DTD often co-occur with, but can be distinguished from, those of PTSD and comorbid psychiatric disorders. However, the question of whether DTD has structural integrity and distinctiveness when directly compared to PTSD has not been investigated.

DTD parallels, but differs in important ways from, the added features of Disturbances in Self Organization (DSO) that are included in the *International Classification of Diseases* 11th Revision's adult Complex PTSD (CPTSD). Confirmatory factor analyses have shown that PTSD and DSO represent correlated latent variables with a hierarchical structure in which each construct is represented by multidimensional first- order factors corresponding to the symptom features of PTSD and of DSO (Cloitre et al., 2019; Haselgruber et al., 2020; Hyland et al., 2017; Kazlauskas et al., 2020; Murphy et al., 2018). DTD includes symptoms of dysregulation that extend beyond and are organized in some different ways than DSO. Both DSO and DTD have symptom criterion sets representing emotion and relational dysregulation. DSO includes a separate symptom set for negative self-perceptions, while DTD combines self and relational dysregulation based on evidence that, in childhood and adolescence, relationships and self-concept are in flux and heavily impacted by maltreatment.(Ju & Lee, 2018) Cognitive and behavioral dysregulation are not found in the DSO symptoms, but are included in DTD due to evidence of reactive attitudes and behavior among traumatized children. (D'Andrea et al., 2012). Despite these developmentally-based differences, DTD and DSO have been described as having similar relationships to PTSD, so evidence to that effect for DTD could provide a bridge from adult CPTSD to the existence of a similarly complex post-traumatic syndrome in childhood. Research with children in foster care (Haselgruber et al., 2020), adolescents, (Kazlauskas et al., 2020), and young adult genocide survivors (Murphy et al., 2018) has tested the structure of PTSD and DSO with children, supporting either a hierarchical model with two correlated higher-order factors representing PTSD and DSO (Haselgruber et al., 2020) or of correlated factors corresponding to the PTSD and DSO domains (Kazlauskas et al., 2020; Murphy et al., 2018).

The aim of this study therefore was to test alternative factor analytic models of DTD and PTSD using data from a large sample of help-seeking children and adolescents. The alternative models tested are shown in Fig. 1. Model 1 is a unidimensional model with all DTD and PTSD symptom indicators representing a single 'trauma response' latent variable. Model 2 has two correlated first-order latent variables, DTD and PTSD, with DTD and PTSD symptom indicators loading only on their respective latent variables. Model 3 has a multidimensional structure with three DTD latent variables (Emotional, Behavioral, and Self dysregulation) and three PTSD latent variables (Re-experiencing, Avoidance, and Arousal) and all latent variables correlated. Model 4 is a hierarchical variant of Model 3, with two correlated second-order latent variables, DTD and PTSD, which are specified to explain the variation and covariation among their 3 respective first-order latent variables.

On the basis of theory (and the scoring of the DTD-SI and the KSADS PTSD module) DTD and PTSD are separate disorders and have a multidimensional and hierarchal organization of symptoms. Therefore it is hypothesized that Models 2, 3 and 4 would better fit the data than the single disorder Model 1; that multidimensional Model 3 and

hierarchical Model 4 would be better fitted than Model 2; and that Model 4 would be better fitted than Model 3 (as Model 4 is both multidimensional and hierarchal). However, these models also differ in complexity, with Models 1 and 2 having the fewest parameters to estimate, and therefore simpler than Models 3 and 4. Therefore, the evaluation of the best model will be based on model fit, alignment with theory, and quality of the model estimates.

The second aim of this study is to explore the association between a range of different types of trauma exposure and the latent variables from the factor analyses. When the optimal factor analytic model was determined, the model was extended to include (1) a range of trauma variables, and (2) a variable representing cumulative trauma exposure. Previous studies with this (Spinazzola et al., 2018) and other (Wamser-Nanney & Vandenberg, 2013) child samples have demonstrated an association between complex exposure to traumatic stressors with externalizing and internalizing disorder symptoms that extend beyond PTSD, consistent with the inclusion of DTD symptoms in the current study. Therefore, it is hypothesized that latent variables that are characterized by DTD symptoms will be more strongly associated with complex forms and combinations of traumatic stressors than latent variables characterized by PTSD symptoms.

Methods

Participants

A convenience sample of families of 507 children and adolescents in the age range of 7 to 18 years (M = 12.11, SD = 2.92), comprising 244 female and 260 male participants (three did not report their gender) was recruited from 8 sites located in four geographical regions in the United States (Northeast, Mid-Atlantic, South, and Midwest) by announcing the study to mental health, social, work and pediatric practitioners and agencies including community and university-based mental and public health clinics and practice groups. Age (between 7 and 18 years old) and willingness to provide assent (child) and informed consent (parent) for participation were the only inclusion/exclusion criteria. Participants' ethnic/racial backgrounds were as follows: 50.5% White, 19.5% Black, 12.8% Hispanic, 2.2% Asian, 9.5% Biracial, and 2.8% reported their race or ethnicity as another that was unspecified.

Most children/adolescents were in outpatient psychiatric (N = 347, 68.5%) or residential mental health (N = 113, 22.5%) treatment. Their other psychiatric diagnoses included depression (N = 299, 59.0%), attention-deficit/hyperactivity disorder (N = 283, 55.8%), generalized anxiety disorder (N = 270, 53.3%), oppositional-defiant disorder (N = 249, 49.1%), separation anxiety disorder (N = 216, 42.6%), conduct disorder (N = 137, 27.0%), phobia (N = 113, 22.3%), bipolar disorder (N = 84, 16.6%), psychosis (N = 63, 12.4%), and panic disorder (N = 51, 10.1%).Their trauma histories included: non-interpersonal trauma (N = 375, 74.0%), physical abuse/assault (N = 262, 52.7%), traumatic loss (N = 246, 58.5%), traumatic caregiver separation (N = 228, 45.0%), traumatic caregiver impairment (N = 211, 41.6%), family violence (N = 195, 38.5%), sexual trauma (N = 105, 20.7%), traumatic emotional abuse (N = 101, 19.9%), traumatic neglect (N = 95, 18.7%), and community violence (N = 89, 17.6%). On average, the total number of types of traumatic stressors experienced by child/youth participants was 3.89 (SD = 2.34, Range = 0–10).

Procedure

All study procedures were conducted following a protocol approved by the Institutional Review Board of the University of Connecticut Health Center (IE-11-096-2), with informed consent obtained by a parent/legal guardian and assent obtained from participating children.

Interviews were conducted with 245 parent-child dyads, 238 parents alone, and alone with 24 adolescents. When children were interviewed with a parent, the child version of the interview (TESI, DTD, K-SADS) was used and parents were asked whether they agreed with the child's response or if they had a different answer than their child. Present (past 30 days diagnoses were used for both DTD and PTSD. Symptoms were considered to be present and traumatic events were considered to have occurred if endorsed by either the parent or child (or both).

Carefully trained and supervised (Ford et al., 2018) interviewers (N = 25) had their first two study interview tapes reviewed by an independent expert with > 80% agreement on the primary interview variables required before conducting further interviews. The expert reviewers were Masters and PhD-level psychologists who were trained, calibrated, and supervised on conducting the DTD interview, the TESI, and the K-SADS PTSD module by the study's Assessment Supervisor (who had been trained and calibrated by the DTD And TESI measure developer and a psychiatrist who specialized in training the K-SADS). Approximately every fifth interview conducted by across all interviewers was independently rated, including 73 interviews with a parent or adult guardian and 36 with a child with or without an adult.

Measures

Developmental Trauma Disorder Semi-Structured Interview (DTD-SI). The DTD-SI items were initially developed by experts from the National Child Traumatic Stress Network. After iterative review/revisions, DTD-SI version 10.0 was used in the first phase of this study with N = 236 participants, with evidence of internal consistency and inter-rater reliability, invariance across age, gender, and race/ethnicity, and convergent, criterion, discriminant, and construct validity (Ford et al., 2018). Version 10.6 was used in the second phase with N = 271 participants. The DTD symptoms were identical in both versions of the DTD-SI (see Table 1). Version 10.0 allowed for both threshold and sub-threshold ratings, with either score counted as the symptom was present (Ford et al., 2018). Version 10.6 scored symptoms only as present or absent, based on the symptom occurring with either evident distress or detachment. Fifteen DTD symptoms were scored (Present = 1, Absent = 0) representing three proposed DTD symptom clusters: Emotion/somatic dysregulation symptoms (4 items), Attentional or behavioral dysregulation symptoms (5 items), and Interpersonal or self- dysregulation symptoms (6 items). Inter-rater agreement across raters for all DTD-SI items was 87–100% (M = 93.0% agreement on child interviews; 93.5% agreement on parent/guardian interviews).

Kiddie Schedule for Affective Disorders and Schizophrenia, Present/ Lifetime Version (KSADS/PL). This semi-structured interview assesses DSM-IV child psychiatric disorders with child and parent versions (Kaufman et al., 1996). PTSD symptoms were assessed with a module that assessed 17 symptoms (Present = 1, Absent = 0) in 3 symptom clusters: re-experiencing (5 items), avoidance (7-items), and arousal (5 items). Inter-rater agreement on K-SADS PTSD items was 81–100% (M = 85% and 89% agreement for child and parent/guardian interviews, respectively).

Traumatic Experiences Screening Instrument (TESI). This semi-structured interview assesses lifetime history of exposure to traumatic stressors as defined in the *DSM*-IV (i.e., "experienced, witnessed, or been confronted with an event that involves actual or threatened death or injury, or a threat to the physical integrity of self or others" with an emotional response of "intense fear, helplessness, or horror"—American Psychiatric Association, 1994, p. 467). If a potentially traumatic event is disclosed in response to initial queries describing specific types of trauma, probes were used to determine the age(s) at which the event(s) occurred and what other persons were involved. Binary variables are calculated for 10 composite categories of trauma: (1) Non-interpersonal trauma (i.e., accident, illness, or disaster; A2 TESI1.1-1.5), (2) Traumatic loss (TESI_1_5h = 1 or TESI_1_6J = 1), (3) Physical abuse/assault (TESI_2.1j = 1 or TESI_2.2j = 1 or TESI_2.3j = 1 or TESI_2.4j), (4) Witnessing family violence (TESI_3.1k = 1 or TESI_3.2z = 1), (5) Sexual trauma (TESI_5.1j = 1 or TESI_5.2j = 1), (6) Witnessing community violence (TESI_4.1k = 1 or TESI_4.2k = 1), (7) Separation from primary caregiver (TESI_1_7n = 1), (8) Impairment of primary caregiver (TESI_1.8 h = 1 or TESI_1.9r = 1 or TESI_3.3j = 1), (9) Emotional Abuse (TESI_6.1hj = 1); (10) Neglect (TESI_6.2k = 1). A dichotomous score for polyvictimization also is calculated (i.e., 5 or more types of interpersonal trauma, #3–10 above). TESI items have shown evidence of retest reliability over a 2–4 month period (Kappa [K] = 0.50-0.70) and criterion and predictive validity in psychiatric and pediatric samples (Daviss et al., 2000). In the current sample, inter-rater agreement across all raters for all TESI composite scores was 88–100% (*M* = 97% agreement for both child and parent/guardian interviews).

Table 1 Developmental Trauma Disorder (DTD) Symptom Criteria

Criterion B (current emotion or somatic dysregulation, 4 items; 3 required for DTD)	
	B1: Emotion dysregulation
	B2: Somatic dysregulation
	B3: Impaired access to emotion or somatic feelings
	B4: Impaired verbal mediation of emotion or somatic feelings
Criterion C (current attentional or behavioral dysregulation, 5 items; 2 required for DTD)	
	C1: Attention bias toward or away from threat
	C 2: Impaired self-protection
	C 3: Maladaptive self-soothing
	C4: Non-suicidal self-injury
	C5: Impaired ability to initiate or sustain goal-directed behavior
Criterion D (current relational- or self-dysregulation, 6 items; 2 required for DTD)	
	D1: Self-loathing or self viewed as irreparably damaged and defective
	D 2: Attachment insecurity and disorganization
	D 3: Betrayal-based relational schemas
	D4: Reactive verbal or physical aggression
	D5: Impaired psychological boundaries
	D6: Impaired interpersonal empathy

Statistical Analyses

Descriptive statistics were conducted in IBM SPSS v. 26. Latent variable modelling was conducted in 3 phases. In the first phase, a series of confirmatory factor analytic (CFA) models were specified and tested. Alternative models were tested, and are shown in Fig. 1. As described above, Model 1 is a unidimensional model and Model 2 proposes 2 correlated first-order latent variables, DTD and PTSD, while Models 3 and 4 are multidimensional with Model 4 additionally having a hierarchical structure. Due to the binary nature of the observed variables the robust weighted least squares estimator (WLSMV) based on the tetrachoric correlation matrix of latent continuous response variables was used. A preliminary test assessed the factorability of the data by calculating eigenvalues, and the data were determined to be appropriate for the CFA if two or more eigenvalues were greater than 1. To assess model fit standard recommendations were followed (Padgett & Morgan, 2019): a non-significant chi-square (χ^2), Comparative Fit Index (CFI) and Tucker Lewis Index (TLI) values above 0.95 reflect excellent fit, while values above 0.90 reflect acceptable fit; Root-Mean-Square Error of Approximation (RMSEA) with 90% confidence intervals with values of 0.06 or less or 0.08 or less reflecting, respectively, excellent or acceptable fit. The same cut-off values can be used for the Standardized Root Mean-square Residual (SRMR: Jöreskog & Sörbom, 1996). The best CFA solution will also be evaluated in terms of the magnitude of the factor loadings, which should be generally above 0.70 (Bandalos & Finney, 2010), and factor correlations. The magnitude of the factor correlations will be evaluated in the context of the overall hypotheses that DTD and PTSD represent separate but related disorders; so, the expectation is that all the symptom clusters would be positively correlated at a moderate to high level (0.70 to 0.90 based on meta-analysis by Yufik & Simms 2010) and the within disorder correlations would be stronger than the between disorder correlations. The between disorder correlations would be expected to be around 0.50 based on the meta-analytic findings (Krueger & Markon, 2006). Analyses were done with Mplus version 8.2 (Muthén & Muthén, 2017).

In the second phase the models were compared using the DIFFTEST (http://statmodel.com/download/webnotes/webnote10.pdf2006). As the DIFFTEST can be sensitive to sample size, this was supplemented calculating the difference in model CFIs and using Cheung and Rensvold's (2002) criterion of greater than a 0.01 change being indicative of a meaningful difference. The information theory based criteria, such as the BIC and AIC, were not available to compare the relative fit of the models as maximum likelihood estimation was too demanding for the Models 3 and 4. In the third phase, two separate models were estimated where predictor variables were added to the best-fitting CFA model. In the first model the variables representing age, gender, and the 10 binary coded TESI trauma variables were all included as predictors; all predictor variables were correlated and hence the model was multivariate in nature, the linear regression coefficients represented the unique effect of each predictor while controlling for the other predictors in the model. In the second model, a summed score of the 10 binary coded TESI trauma variables replaced the 10 individual variables, and this multivariate model also included age and gender as control variables. For both models the regression coefficients were tested for statistical significance at the 0.05 level.

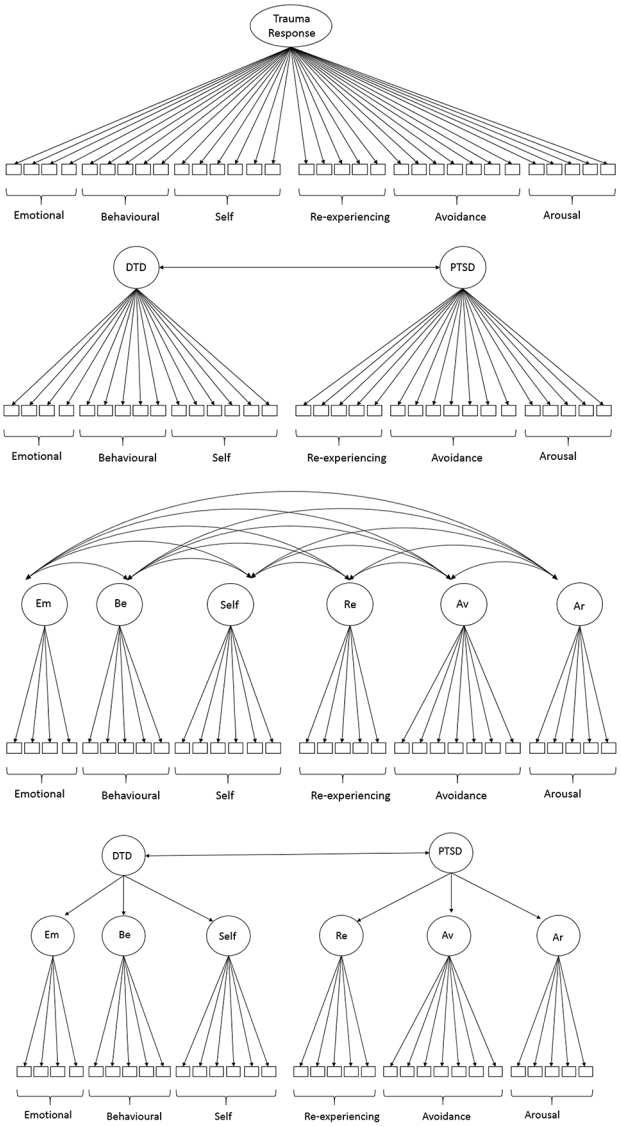

Fig. 1 Alternative Factor Models Model 1

Missing data on the DTD and PTSD indictors were found on 4 items ranging from 0.4 to 1.2%. The pairwise present method was used for factor analyses, with exogenous variables added to the model as predictors. Trauma variables had 1.4% missing data, and were estimated, thereby making them endogenous and retaining the effective sample size at 507.

Results

Table 2 shows endorsement rates for the KSADS PTSD and DTD-SI. The endorsement rates for PTSD items ranged from 16.4% (C7 PTSD) to 50.9% (D2_PTSD), $M = 34.9\%$. DTD item endorsement rates ranged from 8.7% (DTD 6) to 66.1% (DTD 1), $M = 41.1\%$.

The first 6, of 32, eigenvalues were greater than 1 (14.421–1.039) and this is indicative of multidimensionality. Table 3 shows the fit statistics for the CFA models. Model 1 did not meet the criteria for acceptable model fit, and was rejected as a candidate model. The other models demonstrated acceptable model fit on all indices except the chi-square; this however, should not lead to the rejection of models as there are other factors that are associated with the magnitude of the chi-square other than the degree of model misspecification. First, the chi-square test is based on a test of exact fit, the null hypothesis is that there is no difference between the sample and model-implied covariance matrices, and this is an overly restrictive null hypothesis and can result in over-rejection of reasonable models (MacCallum, Widaman, Preacher, & Hong, 2001). Second, as sample sizes increase the power of the chi-square test increases and can lead to over-rejection of models (Tanaka, 1987). However, the RMSEA, CFI, and TLI, were all very similar for models 2, 3, and 4 and were indicative of reasonable model fit; the models were largely indistinguishable on the basis of these overall fit statistics, although the CFI and TLI were highest, and the RMSEA and SRMR lowest, for Model 3. It should be noted that the SRMR was above the recommended threshold for models 2, 3, and 4, albeit the value for model 3 was, at 0.089, only marginally too high[1]. The results of the DIFFTEST indicated that, based on the chi-square statistic, Model 3 ($\Delta\chi^2 = 105.62$, $\Delta df = 14$, $p < .001$) and model 4 ($\Delta\chi^2 = 48.10$, $\Delta df = 6$, $p < .001$) were better than Model 2, and Model 3 was better than Model 4 ($\Delta\chi^2 = 66.05$, $\Delta df = 8$, $p < .001$). The difference in the CFIs for Model 2 and 3 ($\Delta CFI = 0.008$) and Model 4 and 3 ($\Delta CFI = 0.005$) were lower than the threshold proposed by Cheung and Rensvold's (2002). So, although equivocal, the results suggest that the DTD and PTSD indicators were best described as six correlated first-order latent variables (Model 3).

Table 4 shows the factor loadings and factor correlations. All factor loadings were positive, strong, and statistically significant. The within disorder correlations were very high for PTSD, ranging from $r = .725$ to $r = .991$, as they were for DTD; indeed the correlation between Re-experiencing and Avoidance was out-of-bounds (1.010). The cross-disorder correlations were smaller in magnitude, ranging from $r = .443$ to 0.631. To compare the magnitude of within disorder versus between disorder correlations for PTSD and DTD, the MODEL CONSTRAINT command in Mplus was used to create three variables that represented the average within disorder correlation for PTSD, DTD and the between disorder correlations. These were then tested for mean differences in magnitude using a Wald chi-square test using the MODEL TEST function. Within disorder correlations for PTSD ($M = 0.978$: $\chi^2(1) = 29.815$, $p < .001$) and

Table 2 Endorsement Rates for PTSD and DTD Symptom Items

PTSD	%	n	DTD	%	n
B1 PTSD	38.3%	194	DTD 1	66.1%	335
B2 PTSD	31.8%	161	DTD 2	33.3%	169
B3 PTSD	38.9%	197	DTD 3	18.7%	95
B4 PTSD	37.8%	191	DTD 4	29.4%	149
B5 PTSD	31.8%	161	DTD 5	41.4%	210
C1 PTSD	45.2%	229	DTD 6	8.7%	44
C2 PTSD	35.5%	180	DTD 7	42.8%	217
C3 PTSD	31.8%	161	DTD 8	9.1%	46
C4 PTSD	27.2%	138	DTD 9	40.8%	207
C5 PTSD	36.3%	184	DTD 10	26.4%	134
C6 PTSD	24.7%	125	DTD 11	27.6%	140
C7 PTSD	16.4%	83	DTD 12	26.6%	135
D1 PTSD	38.9%	197	DTD 13	24.5%	124
D2 PTSD	50.9%	258	DTD 14	15.3%	77
D3 PTSD	43.9%	220	DTD 15	23.5%	119
D4 PTSD	35.7%	179			
D5 PTSD	30.3%	152			

Table 3 Fit Statistics for Alternative Models of DTD and PTSD

Model	χ^2 (df) p	RMSEA	CFI	TLI	SRMR
1	2521.545 (464) p < .001	0.094 (0.090, 0.097)	0.844	0.833	0.154
2	1232.321 (463) p < .001	0.057 (0.053, 0.061)	0.941	0.937	0.097
3	1117.432 (449) p < .001	0.054 (0.050, 0.058)	0.949	0.944	0.089
4	1191.416 (457) p < .001	0.056 (0.052, 0.060)	0.944	0.939	0.093

[1] We propose that the high SRMR is attributable to local misfit rather than global model misfit as the post-hoc addition of a single parameter could lower the SRMR to acceptable limits. For example, adding a correlated residual between D5 DTD (Psychological boundary deficits) and D6 DTD (Impaired capacity to regulate empathic arousal) results in improved fit ($\chi^2 = 942.074$, $df = 448$, $p < .001$; RMSEA = 0.047 (90%CI = 0.042, 0.051); CFI = 0.962; TLI = 0.958; SRMR = 0.079).

Table 4 Factor Loadings (s.e.) and Factor Correlations (s.e.) for the Six-Factor Model (Model 3)

Symptom/ Indicator	Emotional dysregulation	Behavioral dysregulation	Self- dysregulation	Re-experiencing	Avoidance	Arousal
B1 DTD	0.871 (0.040)					
B2 DTD	0.804 (0.042)					
B3 DTD	0.674 (0.052)					
B4 DTD	0.720 (0.042)					
C1 DTD		0.772 (0.039)				
C2 DTD		0.695 (0.049)				
C3 DTD		0.826 (0.033)				
C4 DTD		0.562 (0.066)				
C5 DTD		0.616 (0.045)				
D1 DTD			0.706 (0.046)			
D2 DTD			0.722 (0.045)			
D3 DTD			0.937 (0.031)			
D4 DTD			0.689 (0.045)			
D5 DTD			0.979 (0.024)			
D6 DTD			0.926 (0.022)			
B1 PTSD				0.771 (0.031)		
B2 PTSD				0.668 (0.038)		
B3 PTSD				0.770 (0.033)		
B4 PTSD				0.841 (0.025)		
B5 PTSD				0.810 (0.027)		
C1 PTSD					0.831 (0.029)	
C2 PTSD					0.834 (0.028)	
C3 PTSD					0.707 (0.036)	
C4 PTSD					0.756 (0.032)	
C5 PTSD					0.850 (0.025)	
C6 PTSD					0.697 (0.037)	
C7 PTSD					0.710 (0.041)	
D1 PTSD						0.802 (0.031)
D2 PTSD						0.815 (0.033)
D3 PTSD						0.778 (0.033)
D4 PTSD						0.798 (0.031)
D5 PTSD						0.812 (0.028)
Beh-Dysreg	0.901 (0.037)					
Self-Dysreg	0.725 (0.038)	0.991 (0.033)				
Re-Exp	0.621 (0.049)	0.574 (0.055)	0.443 (0.051)			
Avoidance	0.630 (0.048)	0.537 (0.053)	0.506 (0.047)	1.010 (0.019)		
Arousal	0.631 (0.047)	0.579 (0.053)	0.488 (0.048)	0.989 (0.020)	0.935 (0.021)	

Note: Re-Exp = Re-experiencing; Beh = behavioral; Dysreg = dysregulationl all coefficients are $p < .001$

DTD ($M = 0.872$: $\chi^2(1) = 68.156$, $p < .001$) were significantly higher than between disorder correlations ($M = 0.557$), and the correlations for PTSD were higher than for DTD ($\chi^2(1) = 12.958$, $p < .001$).

Table 5 shows the regression coefficients when the trauma variables were added to the model. The model fitted reasonably well ($\chi^2 = 1424.265$, df = 761, $p < .001$; RMSEA = 0.042 (90%CI = 0.038, 0.045); CFI = 0.950; TLI = 0.942; SRMR = 0.082). Traumatic loss predicted the PTSD Avoidance latent variable, and traumatic witnessing of family violence predicted DTD Self Dysregulation and PTSD Re-experiencing and Avoidance latent variables. Table 6 shows that the cumulative trauma variable significantly predicted the DTD Behavioral and Self Dysregulation latent variables and PTSD Re-experiencing and Arousal latent variables ($\chi^2 = 1199.320$, df = 527, $p < .001$; RMSEA = 0.051 (90%CI = 0.047, 0.054); CFI = 0.950; TLI = 0.944; SRMR = 0.090).The regression coefficients were similar in magnitude for each variable, indeed when these coefficients were constrained to be equal there was no significant decrement in model fit ($\Delta\chi^2 = 4.647$, Δdf = 3, p = .199). In both regression analyses, female gender was associated with PTSD latent variables but not with DTD latent variables.

Table 5 Standardized Regression Coefficients (95% CI) For Trauma Variables Predicting PTSD and DTD Latent Variables

	DTD			PTSD		
	Em	Be	Self	Re	Av	Ar
Age	0.113* (0.007, 0.219)	0.078 (-0.030, 0.186)	0.086 (-0.016, 0.188)	058 (-0.045, 0.162)	0.151*(0.052, 0.251)	0.037 (-0.064, 0.137)
Gender	0.074 (-0.031, 0.180)	0.010 (-0.099, 0.118)	−0.001 (-0.102, 0.099)	−0.110 (-0.212, −0.007)	−0.147* (-0.245, −0.049)	−0.076 (-0.177, 0.024)
Non-interpersonal trauma	0.032 (-0.089, 0.152)	−0.008 (-0.130, 0.115)	0.014 (-0.101, 0.130)	−0.020 (-0.141, 0.101)	−0.020 (-0.138, 0.097)	0.020 (-0.098, 0.137)
Traumatic loss	0.020 (-0.098, 0.138)	0.068 (-0.054, 0.191)	0.078 (-0.033, 0.188)	0.097 (-0.022, 0.216)	0.147*(0.033, 0.262)	0.090 (-0.027, 0.206)
Traumatic separation from primary caregiver	0.062 (-0.065, 0.188)	0.027 (-0.110, 0.164)	0.034 (-0.083, 0.152)	−0.036 (-0.164, 0.093)	-0.041 (-0.165, 0.083)	0.008 (-0.118, 0.134)
Traumatic caregiver impairment	−0.085 (-0.210, 0.040)	−0.017 (-0.153, 0.118)	−0.091 (-0.215, 0.032)	0.027 (-0.102, 0.156)	-0.001 (-0.126, 0.123)	−0.023 (-0.149, 0.102)
Physical abuse/assault trauma	0.014 (-0.101, 0.130)	0.052 (-0.067, 0.170)	0.065 (-0.043, 0.172)	0.060 (-0.053, 0.173)	0.066 (-0.041, 0.173)	0.062 (-0.047, 0.171)
Sexual trauma	−0.016 (-0.133, 0.100)	−0.039 (-0.151, 0.073)	0.051 (-0.050, 0.152)	0.070 (-0.035, 0.175)	0.025 (-0.078, 0.127)	0.017 (-0.086, 0.120)
Witnessing traumatic family violence	0.103 (-0.018, 0.225)	0.095 (-0.027, 0.217)	0.123*(0.012, 0.233)	0.128*(0.017, 0.238)	0.112* (0.002, 0.222)	0.099 (-0.012, 0.210)
Witnessing traumatic community violence	−0.029 (-0.141, 0.084)	−0.014 (-0.130, 0.101)	−0.066 (-0.174, 0.042)	0.048 (-0.058, 0.154)	0.021 (-0.082, 0.124)	0.046 (-0.057, 0.149)
Traumatic Emotional Abuse	0.034 (-0.091, 0.159)	0.043 (-0.079, 0.165)	0.003 (-0.105, 0.112)	−0.061 (-0.176, 0.054)	−0.037 (-0.146, 0.072)	−0.049 (-0.165, 0.067)
Traumatic neglect	−0.001 (-0.119, 0.117)	−0.015 (-0.134, 0.104)	−0.017 (-0.125, 0.092)	−0.071 (-0.188, 0.046)	-0.063 (-0.174, 0.048)	−0.018 (-0.134, 0.098)

Note: *p < .05: Em = Emotional, Be = Behavioral, Self = Self- dysregulation, Re = Re-experiencing, Av = Avoidance, Ar = Arousal

Table 6 Standardized Regression Coefficients (95% CI) for Demographic and Trauma Variables Predicting PTSD and DTD Latent Variables

	DTD			PTSD		
	Em	Be	Self	Re	Av	Ar
Age	0.112* (0.005, 0.218)	0.081 (-0.028, 0.190)	0.086 (-0.014, 0.186)	0.069 (-0.034, 0.172)	0.164** (0.065, 0.262)	0.044 (-0.055, 0.144)
Gender	0.070 (-0.035, 0.175)	0.018 (-0.091, 0.127)	-0.010 (-0.107, 0.087)	-0.111* (-0.214, −0.009)	-0.147** (-0.245, −0.049)	-0.082 (-0.182, 0.019)
Total trauma	0.084 (-0.023, 0.191)	0.111* (0.001, 0.220)	0.108* (0.008, 0.209)	0.109* (0.003, 0.215)	0.092 (-0.009, 0.193)	0.119* (0.015, 0.222)

Note: *p < .05, **p < .01: Em = Emotional, Be = Behavioral, Self = Self- dysregulation, Re = Re-experiencing, Av = Avoidance, Ar = Arousal

Model 2

Discussion

The structure of PTSD and complex traumatic stress symptoms (i.e., disturbances of self-organization) has been studied with adults (Cloitre et al., 2019; Hyland et al., 2017), but this is the first empirical examination of the structure of traumatic stress symptoms conducted with children using a developmentally attuned set of complex traumatic stress symptoms (i.e., the symptoms of Developmental Trauma Disorder). The resultant correlated-factor model with the three criteria from PTSD and the three criteria from DTD parallels the correlated-factor model that best fit the results of the prior CFAs using the *ICD*-11 PTSD and DSO assessment with non-clinical samples of normative community adolescents (Kazlauskas et al., 2020) and genocide-exposed young adults (Murphy et al., 2018). Although the hierarchical model supported by prior findings with children in foster care (Haselgruber et al., 2020) was not the best fit in the current sample, it fit the data better than the unidimensional (i.e., single trauma-related disorder) or two factor (i.e., separate PTSD and DTD syndromes) models. In addition, the stronger inter-correlations within PTSD and DTD domains, compared to latent variable correlations across those domains, suggests that the DTD and PTSD domains are differentiated despite their overall high level of inter-correlation—and this is consistent with a hierarchical model in which DTD and PTSD and are highly interrelated and each has three internally cohesive symptom sub-sets.

Thus, study results suggest that children's trauma-related symptoms are best understood as organized in a multidimensional array that comprise two distinct but highly related sub-groups corresponding to PTSD (i.e., re-experiencing, avoidance, arousal) and DTD (i.e., emotion, cognitive-behavioral, and self-relational dysregulation). Study findings thus suggest that DTD may serve a similar function in demarcating a broader and more complex model of PTSD with children, as DSO does with adults. The three PTSD latent variables in the current study correspond closely with the three PTSD criteria in the *ICD*-11, which is not surprising since both are based on the conceptualization of PTSD in *DSM*-IV. Where DSO limits the "complex" posttraumatic symptoms to a compact set representing emotion dysregulation, interpersonal detachment, and self-perception as worthless or a failure, DTD has a wider range of symptoms including somatic/dissociative expressions of emotion dysregulation (Afari et al., 2014), altered cognitive processing of threats (Weissman et al., 2020b), behavioral disinhibition/dyscontrol (Beauchaine & Cicchetti, 2019; Hankin et al., 2017; Huang-Pollock et al., 2017; Santens et al., 2020; Snyder et al., 2019; Wade et al., 2020), self-devaluation and self-ideal discrepancy (Mason et al., 2019; Schweizer et al., 2020), interpersonal aggression (Ford et al., 2010), dependency (Ford et al., 2009), impaired empathy (McLaughlin et al., 2020; Schweizer et al., 2020), and attachment insecurity (Bryant et al., 2017). DTD symptoms thus overlap with internalizing (e.g., depression, generalized and separation anxiety), externalizing (e.g., oppositional defiant), trauma-related (e.g., reactive attachment) and severe emotional disturbance (e.g., bipolar, obsessive-compulsive) symptoms of childhood. Interestingly, PTSD symptoms were shown to similarly span the internalizing, externalizing and thought disorders in an adult clinical sample (Forbes et al., 2021)/ The current findings raise the question of whether the subset of complex PTSD symptoms may account for this overlap rather than classic PTSD symptoms *per se*, or whether classic PTSD in adulthood has sufficient comorbidities in adulthood to link it to this broader array of dimensions of psychopathology.

Symptoms included in DTD but not in DSO also parallel several Criterion D (negative alterations in cognitions and mood) and E (alterations in arousal and reactivity) PTSD symptoms in the *DSM*-5. PTSD symptom D2 includes negative beliefs about others/relationships, which is explicitly defined as expectancy of betrayal or coercion in DTD symptom D3. The PTSD anhedonia and diminished participation in activities symptom (D5) is modified in DTD symptom C5 which focuses on impairment in a crucial developmental attainment: initiation and sustaining of goal-directed behavior. PTSD symptom E1 (verbal or physical aggression) is mirrored by DTD symptom D4 (reactive verbal or physical aggression). PTSD symptom E2 (reckless or self-destructive behavior) is addressed with greater specificity by DTD symptoms C2 (extreme recklessness or intentional provocation of violence), C4 (non-suicidal self-injury), and D5 (promiscuous enmeshment). Finally, DTD includes an array of somatoform and psychoform dissociative symptoms in Criterion B emotion/somatic dysregulation symptoms (e.g., extreme negative affect states, B1; unexplained physical symptoms, B2; impaired access to or expression of emotions or bodily feelings, B3-B4), where these are limited to a sub-type characterized by deperaonalization and derealization in *DSM*-5 PTSD.

Thus, DTD provides a more extensive and developmentally-attuned set of complex PTSD symptoms than either the DSO symptoms in *ICD*-11 CPTSD or the *DSM*-5 PTSD symptoms. The strong factor loadings of all DTD symptoms and inter-correlation of the three DTD latent variables (corresponding to hypothesized Criteria B, C, and D)—which are comparable to those for the PTSD symptoms and latent variables—suggest that the additional symptoms in DTD are psychometrically justified. From a clinical standpoint, each DTD symptom provides a potential window into an aspect of posttraumatic biopsychosocial dysregulation that can serve as the basis for individualized case conceptualizations and treatment plan and goals. Whether the complexity of DTD's symptoms is of sufficient clinical utility to offset the reduction in parsimony compared to the more streamlined DSO symptom set is a key question for further research. DTD was designed to include a comprehensive set of symptoms based on developmental traumatology research, whereas DSO symptoms were selected to represent the most parsimonious and efficient set of evidence-based sequelae of trauma exposure beyond the core intrusive re-experiencing, avoidance, and hyperarousal symptoms of PTSD. Research simultaneously or sequentially using both DTD and DSO symptoms in clinical assessment and treatment planning is needed to inform

choices about the optimal balance of comprehensiveness and parsimony in this diagnostic arena.

The correlates of the PTSD and DTD latent variables indicate that PTSD is associated with traumatic loss and female gender, but DTD is not. In contrast, witnessing family violence and cumulative trauma exposure were associated with both PTSD and DTD latent variables—although only with the DTD's cognitive/behavioral and self/relational dysregulation but not emotion dysregulation. Thus, exposure to multiple types of traumatic stressors, and particularly to the violence and disruption in primary relationships that occurs in the context of family violence (Lunnemann et al., 2019), is consistent with the conceptualization of DTD as a sequelae of the combination of traumatic victimization and disruption in primary caregiver bonding. This

combination of traumatic antecedents may lead to PTSD, but also to the more complex forms of dysregulation identified in DTD (Spinazzola et al., 2018, 2021). Unlike PTSD, DTD is not conceptualized as a sequelae of loss. DTD also includes externalizing symptoms not included in PTSD, as well as internalizing symptoms, which may account for the absence of a relationship between gender and DTD in contrast to PTSD's association with female gender. It should be noted that no correction for Type I errors was applied when evaluating the statistical significance of multiple parameters in the regression model, and it is unlikely that many of the significant effects would have survived such an adjustment. Future research may focus on a smaller number of more focused predictors to ameliorate this problem.

Although the current study did not investigate the clinical utility of including DTD as well as PTSD in the diagnosis and treatment of children exposed to traumatic stressors, the findings suggest that children exposed to intra-familial violence and related traumatic stressors should be assessed not only for PTSD but also for DTD's dysregulation symptoms. Without DTD as a diagnostic option paralleling the addition of DSO to adult complex PTSD, children will receive trauma-focused treatment only if they present with PTSD symptoms and otherwise will be treated for the (often multiple) internalizing and externalizing disorders for which DTD has been shown to be a frequent comorbidity (Ford, Spinazzola & van der Kolk, 2021).). Omitting DTD as a component of diagnosing trauma-related child psychopathology thus may lead to depriving trauma-affected children of the benefit of evidence-based trauma-focused treatments adapted to address DTD-related dysregulation (Ford & Courtois, 2013; 2020).

Study limitations include a convenience sample that is not representative of community.

populations of children, with an over-representation of children with extensive trauma histories in mental health treatment. It is possible that relationships between specific types of trauma with the DTD or PTSD latent variables may have been obscured by the overall trauma burden carried by this sample of children. The sample had a balanced distribution of Black, Hispanic, and White children, but race/ethnicity was not included as an exogenous variable based on prior findings in this sample that DTD items had comparable information value across race/ethnicity (Ford et al., 2018). DSO represent a potential alternative or complement to DTD that should be assessed in a direct comparison in future studies. Study data were based mainly on parent/guardian interviews, although children were included in approximately one-third of the interviews. Potential effects of nestedness in the data by interviewer or site could not be addressed due to the large number of interviewers ($N = 37$) and the small number of sites ($N = 8$).

Trauma history was assessed by retrospective reports without the prospective longitudinal data necessary to establish the timing and sequence of events and symptoms. Child participants ranged from early school age to late adolescence (i.e., ages 7–17 years), and while DTD symptoms have been found to be largely invariant across this are range (Ford et al., 2018) the effect of potential developmental differences in the presentation and structure of DTD (and PTSD) symptoms in different epochs of childhood/adolescence warrants future research. Finally, the correlation between Re-experiencing and Avoidance was out-of-bounds (1.010); this does not necessarily imply misspecification, rather, in this case it would likely be a very high correlation being estimated at greater than one due to sampling variations (Chen, Bollen, Paxton, Curran, & Kirby, 2001). Indeed, the other 2 PTSD factor correlations were very high, indicating a lack of psychological distinctiveness.

In conclusion, study findings suggest that DTD's dysregulation symptoms are related to but distinct from PTSD's core symptoms. DTD parallels PTSD structurally, and together their symptoms form a set of distinct but correlated array of trauma-related symptoms. The psychometric integrity and independence of DTD was supported by evidence that each DTD symptom loaded strongly on a single DTD latent variable, and the latent variables comprising DTD—although correlated with PTSD latent variables—were significantly more correlated with each other than with the PTSD latent variables. The finding that witnessing family violence and cumulative exposure to multiple types of traumatic stressors were associated with DTD as well as with PTSD underscores the importance of assessing DTD symptoms as well as PTSD symptoms in order to fully account for, and treat, the range of symptoms extending beyond PTSD when children have been exposed to intrafamilial violence or multiple types of trauma (e.g., polyvictimization). DTD thus warrants further research and clinical application as a complement for children of the revised *ICD*-11 CPTSD diagnosis for adults.

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