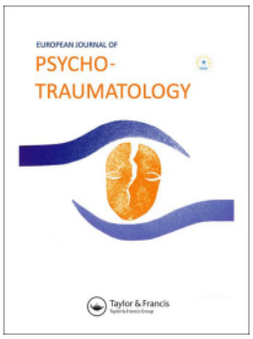

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Cognitive appraisals, cognitive avoidance and rumination as shared vulnerabilities for PTSD and depression in trauma-exposed adolescents

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ABSTRACT

Background: Depression and Post Traumatic Stress Disorder (PTSD) are highly comorbid disorders following trauma exposure; when comorbid they are associated with more deleterious and long-term impact. However, the nature of this relationship lacks consensus and is understudied in adolescence, despite this being highlighted as a critical period for trauma exposure. Cognitive processes such as appraisals, avoidance and rumination have been implicated in both disorders separately and could be potential shared mechanisms underlying this comorbidity.

Method: In a cross-sectional design, 280 secondary school pupils (12–15 years), reporting trauma exposure, completed self-report measures of Post Traumatic Stress Symptoms (PTSS), depression and maladaptive cognitive processes (trauma-related and depressogenic appraisals, cognitive avoidance and rumination).

Results: PTSS and depression symptoms were highly correlated ($r = 0.79$) and 60–65% of all probable diagnostic cases of PTSD or depression were comorbid. Strong positive correlations were found for negative trauma appraisals, depressogenic appraisals, cognitive avoidance and rumination, with statistically comparable strengths found for both PTSS and depression symptoms. Comparisons of probable diagnostic groups showed all groups endorsed all maladaptive processes although the comorbid group showed the greatest endorsement (and symptomology). Stepwise hierarchical regression models of the maladaptive processes explained 75-77% of the variance. Trauma-related appraisals were found most prominent in predicting both PTSS and depression symptoms although a commonality analysis suggested the interplay between all cognitive variables explained the vast amount of variance.

Conclusions: Cognitive appraisals, cognitive avoidance and rumination appear to be shared cognitive vulnerabilities in PTSD and depression, which may underlie PTSD-depression comorbidity and provide targets for intervention.

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Depression; PTSD; comorbidity; adolescents; cognitive mechanisms

PALABRAS CLAVE

Depresión; TEPT; comorbilidad; adolescentes; mecanismos cognitivos

HIGHLIGHTS

- PTSD and depressive symptoms were highly correlated among adolescents; comorbidity appeared to be the norm rather than the exception.
- PTSD and depressive symptoms were similarly associated with negative trauma appraisals, depressogenic appraisals, cognitive avoidance and rumination.
- Trauma appraisals was the strongest predictors of both PTSD and depressive symptoms, although the interplay between all cognitive variables explained the vast amount of variance.

Valoraciones cognitivas, evitación cognitiva y rumiación como vulnerabilidades compartidas para el TEPT y la depresión en adolescentes expuestos a traumas

Antecedentes: La depresión y el trastorno de estrés postraumático (TEPT) son trastornos con alta comorbilidad tras la exposición a un trauma; cuando son comórbidos, se asocian con un impacto más perjudicial y a largo plazo. Sin embargo, la naturaleza de esta relación no está consensuada y se ha estudiado poco en la adolescencia, a pesar de que se considera un período crítico para la exposición al trauma. Procesos cognitivos como las valoraciones, la evitación y la rumiación se han implicado en ambos trastornos por separado y podrían ser posibles mecanismos compartidos que subyacen a esta comorbilidad.

Método: En un diseño transversal, 280 alumnos de secundaria (12-15 años) que reportaron exposición a trauma completaron autoinformes sobre síntomas de estrés postraumático (SEPT), depresión y procesos cognitivos desadaptativos (evaluaciones relacionadas con el trauma y depresógenas, evitación cognitiva y rumiación).

Resultados: Los síntomas de TEPT y depresión mostraron una alta correlación ($r = 0,79$) y entre el 60% y el 65% de los casos con diagnóstico probable de TEPT o depresión fueron comórbidos. Se encontraron fuertes correlaciones positivas para las valoraciones negativas del trauma, las valoraciones depresógenas, la evitación cognitiva y la rumiación, con valores estadísticamente comparables tanto para los síntomas de TEPT como para depresión. Las comparaciones de los grupos con diagnóstico probable mostraron que todos los grupos respaldaron todos los procesos desadaptativos, aunque el grupo con comórbidos mostró el mayor respaldo (y sintomatología). Los modelos de regresión jerárquica por pasos de los procesos desadaptativos explicaron entre el 75% y el 77% de la varianza. Las valoraciones relacionadas con el trauma fueron las más prominentes en la predicción de síntomas de

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TEPT y síntomas de depresión, aunque un análisis de comunalidad sugirió que la interacción entre todas las variables cognitivas explicaba la gran varianza.
Conclusiones: Las valoraciones cognitivas, la evitación cognitiva y la rumiación parecen ser vulnerabilidades cognitivas compartidas en el TEPT y la depresión, que podrían subyacer a la comorbilidad entre el TEPT y la depresión y proporcionar objetivos de intervención.

Introduction

With consistently high comorbidity rates found in epidemiological studies of post-traumatic stress disorder (PTSD) ranging from 78.5 to 84.4% (Qassam et al., 2021; Spinhoven et al., 2014; Breslau et al., 1991), comorbidity for this disorder has been shown to be the rule rather than the exception (Kessler, 1995; Macdonald et al., 2010). Depression is seen to be the most common comorbidity in PTSD, with comorbidity rates of 52% observed in adults (Rytwinski et al., 2013) and 62% in adolescents (Kilpatrick et al., 2003).

The adult literature suggests PTSD-depression comorbidity is particularly problematic, with increased severity of symptoms, disability, chronicity, and suicidality above and beyond that predicted by PTSD or depression alone (e.g. Campbell et al., 2007). Depression symptoms have also been implicated in poorer treatment gains (see review Angelakis & Nixon, 2015), non-response (Zayfert et al., 2005) dropout (Kar, 2011) and poorer quality of life ratings (Araújo et al., 2014) in adult PTSD interventions. An increase in issues has also been found in the adolescent population with greater suicidality (Sher, 2008) and health problems (Seng et al., 2005) found in adolescents with comorbid PTSD-depression. Adolescence is also a critical developmental period particularly sensitive to trauma exposure. However, despite vulnerability to more chronic and deleterious biopsychosocial impacts of trauma exposure (with long-term effects extending into adulthood; Lupien et al., 2009; Ogle et al., 2013), the mechanisms underpinning PTSD-depression comorbidity in adolescents have received relatively little attention.

Understanding comorbidity

Several explanations for PTSD-depression comorbidity in adolescents have been proposed: causative pathways, diagnostic overlap and shared vulnerability. These are outlined below.

PTSD and depression are found to be risk factors for one another in the adult (Breslau et al., 2000; Bromet et al., 1998) and adolescent trauma literature (Mclean et al., 2015a; Roussos et al., 2005; Ying et al., 2012). Exploring the temporal order of development, Kessler et al. (1995) found PTSD preceded the onset of depression in 78% of comorbid adult cases. However, Bleich et al. (1997) found PTSD and depression onset together in 65% of their adult clinical sample. More recently, Schindel-Allon et al. (2010) investigated longitudinal relationships between PTSD and depression in a veteran sample, finding that the onset of depression predicted an increase in PTSD symptoms but not vice versa (i.e. PTSD symptoms did not predict depressive symptoms) and this has been replicated in a sample of adolescent survivors of an earthquake where depression symptoms predicted PTSD symptoms but not the other way around (Ying et al., 2012). Taken together these highly discrepant findings demonstrate at the very least, complex bi-directional relationships from which causation cannot be assumed. Moreover, it does not provide an adequate explanation for the PTSD-depression comorbidity.

Diagnostic overlap between PTSD and depression has also been hypothesised to account for the high comorbidity rates. Three DSM-IV diagnostic symptoms overlap between PTSD and depression, namely anhedonia/diminished interest, sleep difficulties and concentration difficulties. Frueh et al. (2010) reviewed the PTSD empirical database and construct of DSM-defined PTSD and highlighted the heterogeneity of symptoms and concerns regarding symptom overlap and comorbidity with other mood and psychiatric anxiety disorders. That said, Ford et al. (2009) demonstrated PTSD-depression comorbidity in adolescents remained fundamentally unchanged after the removal of the overlapping symptoms. Furthermore, despite the DSM-5 introducing a new cognition and mood symptom cluster that may be considered characteristic of depression, O'Donnell and colleagues (2014) found no significant differences in PTSD-depression comorbidity rates between DSM-IV and DSM-5, suggesting diagnostic overlap may not fully explain the PTD-depression comorbidity.

A subset of dysphoria PTSD symptoms is suggested to be more related to depression than other subsets (Contractor et al., 2014; Gros et al., 2010) and is hypothesised to account for PTSD-depression comorbidity (Yufik & Simms, 2010). However, contrary evidence demonstrates no difference between the subsets (Charak et al., 2014; Horesh et al., 2017). Furthermore, Elhai et al. (2011) found PTSD and depression symptoms represented a single underlying construct, remaining unchanged when the dysphoria subset was removed. The general empirical picture now recognises that comorbidity between PTSD and depression is more complex than mere symptom overlaps, with temporal changes and gender differences recognised in adult samples (Horesh et al., 2017), although there are clear diagnostic issues.

Whilst some postulate PTSD and depression to be distinct and independent sequelae (Cao et al., 2015; Post et al., 2011), evidence of frequent common predictors (see Stander et al., 2014 for a review of the combat-related PTSD literature including genetic studies) and similar courses of pathology and recovery may support a shared vulnerability model (Dekel et al., 2014; Flory & Yehuda, 2015; Lockwood & Forbes, 2014; O'Donnell et al., 2004). The concept of a single latent construct of general traumatic distress has been proposed (Elhai et al., 2011). In support of this, O'Donnell et al. (2004) found predictors of symptom severity and diagnostic category for PTSD and comorbid PTSD-depression largely indistinguishable. Furthermore, studies employing confirmatory factor analysis and latent profile analysis suggest although PTSD and depression may be different manifestations, symptoms reflect a single latent construct longitudinally (Au et al., 2013; Dekel et al., 2014). Whilst the literature base is inconsistent and limited in its findings, particularly in the seeming absence of adolescent literature, shared vulnerability appears to be a promising avenue to further understanding of PTSD-depression comorbidity.

Further research into the mechanisms underlying this shared vulnerability is vital to address the lacking literature. This would also be key to reducing the aforementioned long-term adverse impacts on adolescents and to improving assessment and treatment outcomes.

Putative shared cognitive vulnerabilities

Maladaptive cognitive processes implicated in PTSD and depression separately have been identified by Angelakis and Nixon's review (2015) as candidate underlying mechanisms that explain the shared vulnerability for PTSD-depression comorbidity. The evidence base for cognitive appraisals, cognitive avoidance and rumination as potential shared cognitive vulnerabilities are discussed below.

Cognitive appraisals are defined as a process of evaluation in a framework of meaning-making; particularly in the context of stressful events, where negative appraisals are hypothesised to impact distress and adjustment (Park, 2010). Beck (1976) proposed depressogenic appraisals about the self, world and future, which have been shown predictive of depressive symptoms in adolescents (Braet et al., 2015). Within PTSD, Ehlers and Clark's (2000) cognitive model posits negative cognitive appraisals of trauma (influenced by pre-trauma vulnerability) as integral to the onset and maintenance of PTSD, engendering a current sense of threat and promoting the use of maladaptive control strategies. Negative appraisals have been consistently implicated in both acute and chronic posttraumatic reactions including PTSD and depression symptoms in adolescents (Ellis et al., 2009; Meiser-Stedman, Smith et al., 2009a). Furthermore, changes in negative appraisals are seen to drive change in PTSD and depression symptoms, but not vice versa (McLean et al., 2015b; Zalta et al., 2014), suggesting negative appraisals play a key and causal role in both PTSD and depression.

Cognitive avoidance is a coping mechanism employing mental control or disengagement strategies to orient away from threatening thoughts or affect. Cognitive avoidance strategies are hypothesised to interfere with the ability to evaluate or update negative appraisals as well as impede emotional processing, thus theorised as important in the maintenance of PTSD and depression (Ehlers & Clark, 2000; Ottenbreit & Dobson, 2004; Teasdale, 1999). Cognitive avoidance strategies have been shown predictive of acute trauma reactions and chronic PTSD in adults, children and adolescents (Dunmore et al., 2001; Ehlers et al., 2003; Meiser-Stedman et al., 2014). Although Blalock and Joiner (2000) found cognitive avoidance predictive of depression following stressful life events, research exploring trauma and cognitive avoidance in depression is still limited.

Rumination is implicated in a wide-range of psychopathology and is a process characteristically repetitive, passive and/or relatively uncontrollable and with negative focus, although with suggestion of disorder-specific content (Ehring & Watkins, 2008). Rumination is considered multifaceted with several proposed mechanisms underlying its role in PTSD and depression, such as cognitive avoidance, exacerbating negative affect and strengthening negative appraisals (Ehlers & Clark, 2000; Michael et al., 2007; Nolen-Hoeksema et al., 2008). Rumination has been consistently implicated in the development and maintenance of both PTSD and depression separately in adolescents (Jenness et al., 2016; Meiser-Stedman et al., 2014; Michl et al., 2013; Roelofs et al., 2009).

Study aims

Although negative appraisals, cognitive avoidance and rumination have been studied to varying degrees in PTSD and depression in the adult literature, paucity exists in the adolescent literature. Furthermore, no study to our knowledge has explored these variables in PTSD and depression in the same study comparatively. The present study consists of four aims:

(1) Establish the strength of the association between post-traumatic stress symptoms (PTSS) and depression symptoms and the prevalence of probable comorbidity in a community sample of adolescents;
(2) Establish the relationship between negative appraisals (both trauma-related and depressogenic),

cognitive avoidance and rumination and PTSS and depression symptoms, and identify any specificity in comparative strength of association between these cognitive processes and these two disorders;
(3) Investigate group differences in the proposed cognitive processes and PTSS and depression symptoms in probable diagnostic groups of PTSD-alone, depression-alone and comorbid PTSD-depression; and
(4) Investigate the specificity and commonality of the proposed cognitive processes as predictors of PTSS and depression symptoms.

Method

Sample

Three hundred and ninety-one pupils from two UK secondary schools (years eight and nine) completed questionnaire batteries, representing 71.5% of the total year eight and nine pupil population registered at the two schools. The mean age of the sample was 13.7 years (range 12–15 years old), 51.2% of the sample was female and 97.4% identified their ethnicity as White British. Three children from the eligible sample were excluded from participation following the parental opt-out consent procedure and a further three children chose not to provide assent on the day of data-collection. Any participant questionnaire pack returned with over 20% of missing data overall was excluded ($N = 45$), resulting in a study sample of 346 participants. This excluded sample did not differ significantly from the study sample in age ($t(383) = 0.97$ $p = .92$), gender ($\chi^2(1) = .375$ $p = .541$) ethnicity ($\chi^2(2) = 1.21$ $p = .547$), trauma exposure status ($\chi^2(1) = 2.64$ $p = .104$) or number of trauma types endorsed ($t(388) = 1.74$ $p = .082$). Exposure to potentially traumatic events was reported in 79.9% of the sample; the present study focused principally on these 280 participants.

Measures

Child and Adolescent Trauma Screening (CATS)

The CATS (Sachser et al., 2017) is a screening measure for trauma exposure and DSM-5 PTSS symptoms in children and adolescents aged 7–17 years old. The child-report version employed in the present study has demonstrated good to excellent psychometric properties (e.g. Cronbach's α = .90–94) in child and adolescent samples (Sachser et al., 2017). This measure consists of a lifetime checklist of 15 potentially traumatic events which are endorsed on a yes/no basis and then asks which event may be bothering them most now. If any checklist events are endorsed the respondent then completes the second part, a 20-item questionnaire measuring DSM-5 PTSD symptoms experienced in the past two weeks on a 'never' (0), 'once in a while' (1), 'half the time' (2) or 'almost always' (3) scale. Example items include: 'Feeling as if what happened is happening all over again' and 'Upsetting thoughts or pictures about what happened that pop into your head'. Higher scores equate to elevated PTSS. Impairment of relationships, hobbies/fun, school/work and general happiness is also assessed on a dichotomous yes/no scale.. An algorithm based on a symptom presentation consistent with a DSM-5 diagnosis of PTSD (i.e. one re-experiencing symptom, one avoidance symptom, two negative alternations in cognition and mood and two hyperarousal symptoms where a symptom was deemed to be present if the participant 'once in a while', 'half the time' or 'almost always' to a given item, plus the presence of impaired functioning) was employed to determine likely PTSD caseness. Reliability in the current sample was excellent (Cronbach's α = 0.95).

Revised Child Anxiety and Depression Scale (RCADS)

The RCADS-25 (Muris et al., 2002) is a modified and shortened version of the original RCADS (Chorpita et al., 2000) with comparable psychometric properties (Muris et al., 2002). The measure assesses sub-scales of DSM-defined symptoms of anxiety and depression. The present study employs the 10-item depression subscale; symptoms are assessed on a 4-point response scale of 'how often does this happen to you' (never = 0, sometimes = 1, often = 2, always = 3). The depression subscale has demonstrable good to excellent psychometric properties including internal consistency (Cronbach's α = 0.87), test – retest reliability (r = 0.77), and a reliable T-score cut-off of 65 for determining 'caseness' (Chorpita et al., 2005). Reliability in the present sample was excellent at Cronbach's α = 0.90.

Children's Post-Traumatic Cognitions Inventory Short-Form (CPTCI-S)

The CPTCI-S (McKinnon et al., 2016) is a 10-item self-report measure assessing trauma-related negative appraisals in children and adolescents aged 6–18 years. This is a shortened version of the original CPTCI (Meiser-Stedman et al., 2009b) and has shown excellent internal consistency (α = 0.92) and acceptable test-retest reliability (r = 0.78), (McKinnon et al., 2016). Respondents are asked to rate how much they agree or disagree with each maladaptive appraisal statement since the 'frightening event' on a 4 point scale from 'Don't agree at all' to 'Agree a lot'. Higher scores relate to greater negative trauma-related appraisals. Reliability in the current sample was excellent (Cronbach's α = 0.94).

Cognitive Triad Inventory for Children (CTI-C)

Depressogenic-related negative appraisals were assessed using the CTI-C (Kaslow et al., 1992). This

is a 36-item measure, consisting of three 12-item subscales assessing cognitive appraisals along the three domains of Beck's cognitive triad: view of self, world and future (Beck, 1976). Items are rated on a 3-point scale (Yes, Maybe or No) based on how the child feels 'today'. Internal consistency has been demonstrated as good to excellent for the three subscales (α = 0.80–0.94) and excellent overall (α = 0.92–0.96) with acceptable test-retest reliability in a range of child and adolescent samples aged 9–18 years (Greening et al., 2005; Kaslow et al., 1992). Higher scores relate to more positive appraisals.

Cognitive Avoidance Questionnaire (CAQ)

The CAQ (Sexton & Dugas, 2008) assesses cognitive avoidance strategies using a 5-point Likert scale ranging from 'not at all like me' (1) to 'always like me' (5). Good to excellent internal consistency ($\alpha = 0.83–0.95$) and acceptable test – retest reliability ($r = 0.70–0.85$) has been demonstrated in adolescent and adult samples (Sexton & Dugas, 2008). Higher scores represent increased use of cognitive avoidance. The measure consists of five (5-item) sub-scales of cognitive avoidance strategies; thought suppression, distraction, thought substitution, avoidance of threatening stimuli and transformation of images into thoughts. Uncertainly has been raised regarding conscious accessibility of the latter subscale (Sexton & Dugas, 2008). In view of this and developmental considerations of the target sample, this subscale was excluded and some minor wording simplifications made e.g. happening instead of occurring. Reliability for the overall scale in the current sample was excellent at Cronbach α 0.97 and good to excellent reliability for the subscales (0.84–0.92).

Children's Response Styles Questionnaire (CRSQ)

The CRSQ (Abela et al., 2000) assesses responses in children and adolescents based on Nolen-Hoeksema's (1991) proposed Response Styles Theory, of which rumination is central. The CRSQ consists of three subscales of problem-solving, distraction and rumination, the latter 13-item subscale is used in the present study. Items are rated on a 4-point scale from almost never (0) to almost always (3). The rumination sub-scale has good internal consistency $\alpha = 0.78–0.84$ (Abela et al., 2002) and acceptable test-retest reliability $r = 0.78$ (Abela et al., 2007). Higher scores correspond to increased use of rumination. Reliability in the present sample was excellent at (Cronbach's α = 0.96).

Procedure

Ethical approval for the study was provided by the < removed due to anonymity reasons >. Secondary schools in East Anglia were contacted to register interest in participation; from this, two large interested schools with feasibility for data collection within study timescales were recruited. To maximise participation, representativeness and therefore generalisability, a parental opt-out and participant informed assent process was employed. This opt-out consent process was approved by < removed due to anonymity reasons > and participating schools. Pupils who provided their assent on the day (and whom had not been opted out by their parents/guardians) were given a paper-based questionnaire pack of the study measures. All participants were provided an aftercare sheet detailing support options.

Data analysis

All analyses were carried out using SPSS 23.0. Although continuous variables were positively skewed these values did not fall outside thresholds (+/−1.5) that would suggest concerns (e.g. Tabachnick & Fidell, 2013). Moreover, sample sizes were large ($N = 220–280$) suggesting robustness for parametric testing. Sample sizes varied from the total 280 sample due to some single questionnaires (e.g. RCADS, CATS) not meeting constraints of less than 20% missing data and therefore being excluded from analysis. Despite no concerning violations of normality in the diagnostic groups, caution was taken due to varying degrees of skewness and small sample sizes in some groups. Therefore one-way GLM ANOVA's and Bonferroni post-hoc tests were undertaken with bias-corrected and accelerated bootstraps (1000 samples); these procedures have been shown to increase robustness of statistics for small samples and adequately adjust for non-normality of skewness (DiCiccio & Efron, 1996; Efron, 1987; Neal & Simons, 2007). Where there was heterogeneity of variance a non-parametric Kruskal–Wallis test was used instead of ANOVA. Pearson Coefficient correlations and statistical comparisons of correlational strengths between PTSD and depression symptoms (Lee & Preacher, 2013) were undertaken. Hierarchical regressions were carried out to investigate predictors of symptoms of PTSD and depression.

Finally, syntax (Nimon, 2010) for Commonality Analysis (CA) was employed to explore the unique and common variances in the predictor variables regressed on symptoms of PTSD and depression. This helped mitigate the limitation of the multiple regression approach where beta-weights could be misleading in the presence of high intercorrelation between predictor variables (Courville & Thompson, 2001). Specifically, CA decomposes R^2 into non-overlapping partitions of variance for each variable and each subset of variables. This reveals how much variance each variable uniquely contributes to the

model and the underlying patterns of shared variance between the variables contributing to the model. CA is recommended as a particularly advantageous tool for aiding interpretation of regression in correlated variables and theory building (Kraha et al., 2012; Nimon & Reio, 2011; Ray-Mukherjee et al., 2014) and was therefore used in conjunction with the regression models.

Results

Comorbidity prevalence

Of 280 adolescents reporting lifetime exposure to potentially traumatic events (for frequency of each trauma type, see Supplementary Table 1) the prevalence of probable PTSD and depression was 12.5% ($N = 35$) and 11.4% ($N = 32$) respectively (using the clinical thresholds for the RCADS depression subscale and the PTSD severity sub-scale of the CATS). Figure 1 presents the composition of the exposed sample in terms of unique and comorbid diagnostic cases. Comorbid PTSD-depression made up 45.7% of all diagnostic cases, representing 60% of all PTSD cases and 65.6% of all depression cases in the sample. PTS and depression symptoms were found to be highly correlated in the sample (r = .79, $N = 267$, $p = .001$).

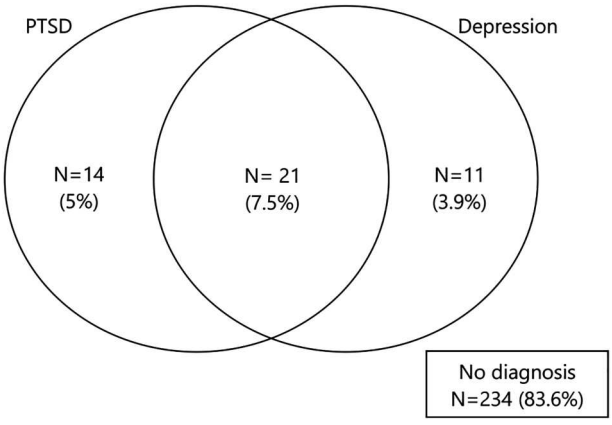

Figure 1. Venn diagram delineating unique and comorbid diagnostic cases.

Associations between cognitive variables and symptoms of PTSD and depression

The zero-order correlations for all variables can be found in Table 1. Correlations between negative cognitive appraisals (trauma-related and depressogenic appraisals) and PTSS and depression symptoms were very high ($r = .72–.82$).

There were no significant differences in correlation strength between PTSS or depression for trauma-related ($r = .82$ vs .78 respectively, $N = 262$) or depressogenic appraisals ($r = -.72$ vs $-.74$, $N = 237$). Correlations for trauma-related negative appraisals were significantly higher than depressogenic negative appraisals in PTSD ($r = .82$ vs $-.72$, $N = 224$, $p = .001$) but not depression ($r = .78$ vs $-.74$, $N = 236$). Cognitive avoidance showed no significant difference in the correlation strength between PTSS and depression (r = .72 vs .71, $N = 270$, $p = .59$). However, the strength of the correlation for rumination was significantly higher in depression ($r = .77$) than in PTSD ($r = .71$), $t(246) = 2.05$, $p = .04$. There was a large degree of association between all the cognitive variables (ranging from $r = .57–.76$).

Diagnostic group differences

To address the third study aim, between-groups analyses were conducted (see Table 2). The groups significantly differed in gender and number of endorsed trauma types, with significantly greater proportions of females in the depression only and comorbid groups and significantly greater number of endorsed trauma types in the comorbid group compared to the no diagnosis group. There were no significant differences with respect to ethnicity.

Other than age, ANOVAs with Bias Corrected and accelerated (BCa) bootstraps showed significant differences between groups on all variables with moderate to large effect sizes (partial η^2 ranging from .34 to .65, $p < .001$). Post-hoc comparisons found that the no diagnosis group had significantly less severe scores on all variables compared to all other diagnostic groups ($p < .001$). The depression only group scored significantly higher than the PTSD only group on

Table 1. Zero-order correlations.

	1	2	3	4	5	6	7	8
1. Age	-							
2. Gender	.05	-						
3. No. of trauma types (CATS)	.06	.04	-					
4. Depression symptoms (RCADS)	.11*	.35**	.31**	-				
5. PTSS (CATS)	.04	.36**	.41**	.79**	-			
6. Trauma appraisals (CPTCI-S)	.04	.33**	.35**	.78**	.82**	-		
7. Depressogenic appraisals (CTI-C)	.001	−.26**	−.33**	−.74**	−.72**	−.76**	-	
8. Cognitive avoidance (CAQ)	.005	.32**	.26**	.71**	.73**	.68**	−.57**	-
9. Rumination (CRSQ)	.03	.36**	.24**	.77**	.71**	.75**	−.73**	.73**

Note: variable measures = 3. Child and Adolescent Trauma Screen (CATS) part 1: trauma checklist; 4. RCADS = Revised Child And Depression Scale – Depression Subscale; 5. CATS Trauma Screen part 2; 6. Child Post Traumatic Cognitions Inventory Scale (CPTCI-S); 7. Children's Cognitive Triad Inventory (CTI-C); 8. Children's Response Style Questionnaire – Rumination Subscale (CRSQ); 9. Cognitive Avoidance Questionnaire (CAQ). *$p < .05$; **$p < .001$.

Table 2. Diagnostic group differences.

Variable	No diagnosis ($N = 234$)	Depression only ($N = 11$)	PTSD only ($N = 14$)	Comorbid group ($N = 21$)	Test statistic[1]
Age, m (sd)	13.73 (0.47)	13.84 (0.54)	13.77 (0.33)	13.84 (0.73)	F (3,276) = 0.55 η_p^2 = .01
% Female	44%[a]	90.9%[b]	71.4%	76.2%[b]	χ^2 (3) = 20.63**
% White British	98.5%	100%	81.7%	95%	χ^2 (6) = 4.44
Mean endorsed trauma types, m (sd)	2.56[a] (1.57)	2.64 (1.21)	3.5 (1.91)	4.76[b] (2.62)	K-W = 21.01**
Depression (RCADS), m (sd)	4.6[a] (3.9)	18.8[c] (3.3)	10.8[b] (3.5)	21.0[c] (4.0)	F (3, 276) = 161.24** η_p^2 = .65
PTSD severity (CATS), m (sd)	10.0[a] (8.4)	23.2[b] (11.1)	30.2[b] (5.3)	41.7[c] (7.8)	F (3, 263) = 108.39** η_p^2 = .55
Trauma appraisals (CPTCI), m (sd)	3.8[a] (4.8)	15.9[b] (5.8)	12.2[b] (6.3)	21.3[c] (6.4)	F (3, 258) = 76.96** η_p^2 = .47
Depressive appraisals (CTI-C)[2], m (sd)	54.3[a] (4.8)	27.7 (13.2)	36.4[b] (9.6)	22.1[c] (10.9)	F (3, 233) = 55.72** η_p^2 = .42
Rumination (CRSQ), m (sd)	8.10[a] (8.2)	27.2[c] (6.9)	17.6[b] (10.0)	29.1[c] (8.0)	F (3, 253) = 55.86** η_p^2 = .40
Cognitive avoidance (CAQ), m (sd)	35.2[a] (14.9)	62.9 (17.9)	55.3[b] (11.9)	71.5[c] (16.3)	F (3, 273) = 45.81** η_p^2 = .34

Note: **$p < .001$. [1]ANOVA tests are reported for continuous variables and χ^2 tests for categorical variables, except for mean endorsed trauma types where a Kruskal-Wallis test was used. [2]Lower scores represent more negative appraisals. CAQ = Cognitive Avoidance Questionnaire; CATS = Child and Adolescent Trauma Screen; CPTCI = Child Post Traumatic Cognitions Inventory; CRSQ = Children's Response Style Questionnaire – Rumination Subscale; CTI-C = Cognitive Triad Inventory – Child; RCADS = Revised Child And Depression Scale – Depression Subscale; Superscript characters indicate significant post-hoc differences.

symptoms of depression and rumination. The comorbid group showed significantly higher PTSS and negative trauma-related appraisals scores than the depression only group, but no other significant differences. The comorbid group scored higher than the PTSD group on all measures.

Cognitive predictors of PTSD and depression

To address study aim four, cognitive predictors of continuous depression and post-traumatic stress symptoms were investigated. Age was the only non-significant variable in univariate linear regressions and thus was not retained for further analysis. Predictor variables were inputted in three blocks into hierarchical multiple regression models for PTSS and depression symptoms. Block one controlled for demographic variables of gender and number of endorsed trauma types; negative appraisals (trauma related and depressogenic appraisals) were entered in block two; and maladaptive cognitive coping strategies (i.e. cognitive avoidance and rumination) were added in block three. While tests for multicollinearity suggested this was not a concern (Gender, Tolerance = .83, VIF = 1.20; Trauma types, Tolerance = .83, VIF = 1.20; Trauma-related appraisals, Tolerance = .27, VIF = 3.77; Depressogenic appraisals, Tolerance = .37, VIF = 2.69; Cognitive avoidance, Tolerance = .39, VIF = 2.59; Rumination, Tolerance = .25, VIF = 4.07), our initial model yielded spurious results that suggested that overlapping variance was an issue (e.g. depressogenic appraisals had negative coefficients; see Supplementary Table 2). We therefore repeated our analyses but not including depressogenic appraisals (see Table 3). The predictors in the regression model accounted for a great degree of variance in both depression (Adj. $R^2 = .72$) and PTSS (Adj $R^2 = .75$). Entry of negative cognitive appraisals resulted in the largest change in R^2, explaining an additional 43% of variance in PTSS and 41% for depression symptoms. Adding cognitive coping strategies (i.e. cognitive avoidance and rumination) resulted in small but significant changes in R^2 explaining a further 9% and 4% of the variance in depression and PTSS, respectively.

Findings revealed unique (predicting variance in one disorder) and shared predictors (both disorders) for PTSS and depression symptoms. Number of endorsed trauma types was the only unique predictor of PTSS. Rumination was the only unique predictor of depression symptoms. Cognitive avoidance and negative trauma-related appraisals were shared predictor variables in PTSS and depression symptoms. Negative trauma-related appraisals were the strongest predictor in the regression model for both PTSS and depression symptoms, but were more strongly related to PTSD.

Table 3. Hierarchical regression analysis: predictors of PTSS and depression symptoms.

	PTSD symptoms ($N = 240$)						Depression symptoms ($N = 245$)					
	Model 1		Model 2		Model 3		Model 1		Model 2		Model 3	
Variables	B	β	B	β	B	β	B	β	B	β	B	β
Gender	8.78	.34**	2.51	.10*	1.58	.06	4.68	.36**	1.65	.13*	0.73	.06
No. trauma types (CATS)	2.81	.40**	0.85	.12*	0.83	.12*	1.06	.30**	0.10	.03	0.14	.04
Trauma appraisals (CPTCI-S)			1.36	.76**	1.01	.56**			0.66	0.74**	0.36	.40**
Cognitive avoidance (CAQ)					0.19	.28**					0.07	.21**
Rumination (CRSQ)					0.02	.02					0.18	.28**
Adj. R^2	.28**		.71**		.75**		.23**		.64**		.72**	
F	48.43		198.89		147.51		36.89		146.04		128.92	
$^{\Delta}R^2$	.28**		.43**		.04**		.23**		.41**		.09**	

Notes: *$p < .05$;**$p < .001$. B = Unstandardised Beta Coefficient, SE = Standard Error, β = standardised Beta Coefficient. $^{\Delta}R^2$ = Adjusted R Squared, F = F-statistic (ANOVA). CAQ = Cognitive Avoidance Questionnaire; CATS = Child and Adolescent Trauma Screen; CPTCI = Child Post Traumatic Cognitions Inventory, short version; CRSQ = Children's Response Style Questionnaire – Rumination Subscale.

Rumination did not account for unique variance in PTSS. A further noteworthy finding was the relative importance of trauma appraisals in PTSS when no differences were found in correlation strengths (i.e. with either PTSS or depression symptoms) and both had comparable structure coefficients. These contrasts suggest interplay between the variables, the underlying dynamics of which are not explicitly revealed in multiple regression models. Indeed, as mentioned above multiple regression models are critiqued to have misleading beta-weights when predictor variables were highly correlated with each other (Courville & Thompson, 2001). For instance, a given variable's beta-weight may receive the credit for variance shared with another variable, which is then withheld from the latter variable's beta-weight. CA was hence conducted to address this.

Commonality analysis: unique and common variance

Table 4 summarises the total unique and common variances contributed by the cognitive predictors for PTSS and depression symptoms. With the exception of trauma-related appraisals in PTSS, which showed a moderate effect size ($R^2 = .10$), the variances accounted for by individual cognitive predictors were small in effect (R^2s = .003 – .04) in models of PTSS and depression symptoms. Trauma-related appraisals also explained the most unique variance in depression symptoms ($R^2 = .04$). The common variance shared between the cognitive predictors was very large (All R^2s > .48).

Table 5 delineates the variance partitions (including first, second and third-order commonality partitions to look at how multiple variables combined may explain the variance) resulting from the commonality analysis, aiding understanding of the unique and shared effects of the variables. First-order commonality refers to the commonality between two predictor variables, second-order commonality refers to the commonality between three predictor variables, and so on. Similar patterns were seen in PTSS and depression symptoms in terms of the largest contributing third- and second-order commonality partitions. The largest partition contributing to R^2 overall was the third-order commonality (i.e. incorporating all four cognitive predictors) which explained 43.4–44.8% of the variance in the overall regression effect ($R^2 = .34$) for PTSS and depression symptoms.

Table 5. Commonality analysis: variance partitions in depression and PTSD symptoms.

	Depression Symptoms		PTSD symptoms	
Variance partitions	R^2	% variance	R^2	% variance
Unique to CTI-C	0.02	3.14	0.03	4.29
Unique to CPTCI-S	**0.04**	5.52	**0.10**	12.34
Unique to CRSQ	0.01	1.04	0.00	0.04
Unique to CAQ	0.02	2.34	0.02	2.83
First-order commonality				
Common to CTI-C, CPTCI-S	**0.04**	4.80	**0.05**	6.34
Common to CTI-C, CRSQ	**0.06**	7.52	0.02	2.56
Common to CPTCI-S, CRSQ	0.02	2.47	0.02	2.49
Common to CTI-C, CAQ	0.00	0.40	0.01	1.63
Common to CPTCI-S, CAQ	0.02	2.99	**0.03**	3.63
Common to CRSQ, CAQ	0.02	2.86	0.01	1.21
Second-order commonality				
Common to CTI-C, CPTCI-S, CRSQ	**0.06**	8.09	**0.03**	4.40
Common to CTI-C, CPTCI-S, CAQ	0.02	2.36	0.03	3.45
Common to CTI-C, CRSQ, CAQ	0.02	2.52	0.00	0.19
Common to CPTCI-S, CRSQ, CAQ	**0.07**	9.11	**0.09**	11.26
Third-order commonality				
Common to CTI-C, CPTCI-S, CRSQ, CAQ	**0.34**	44.82	**0.34**	43.35
Total R^2	0.75		0.78	

Notes: '% variance' indicates per cent of variance in the regression effect that each coefficient contributes. Values in bold represent the largest contributing partitions to R^2 for PTSD and depression symptoms. CAQ = Cognitive Avoidance Questionnaire; CPTCI-S = Child Post Traumatic Cognitions Inventory, short version; CRSQ = Children's Response Style Questionnaire – Rumination Subscale; CTI-C = Cognitive Triad Inventory – Child.

Discussion

The present study explored negative cognitive appraisals, cognitive avoidance and rumination as shared cognitive vulnerabilities in PTSD and depression. This was explored in probable diagnostic group differences as well at continuous symptom level, where we employed correlation, regression and commonality analysis to better understand these relationships.

The present study used a community sample recruited from an English secondary school. The participation rate was high. While not the primary focus of the present study, it is noteworthy that the prevalence rate for trauma exposure was quite high at 79.9%; other surveys of other European and US youth have found similarly high estimates, however (e.g. 68% prevalence, Copeland et al., 2007; 78%, Elklit

Table 4. Unique and common variances of predictors in PTSD and depression symptoms.

	Depression symptoms			PTSD symptoms		
	R^2			R^2		
Variable	Unique	Common	Total	Unique	Common	Total
Trauma-related appraisals	.04	.56	.60	.10	.58	.68
Depressogenic appraisals	.02	.53	.55	.03	.48	.52
Cognitive avoidance	.02	.49	.51	.02	.50	.53
Rumination	.01	.58	.59	.003	.51	.51

& Frandsen, 2014). In the 280 trauma-exposed youth that constituted the sample studied here, the prevalence rates of probable PTSD and depression were also high at 12.5% and 11.4%, respectively.

Comorbidity prevalence

Regarding our first aim, we found that 47.5% of cases meeting thresholds for probable PTSD and/or depression were comorbid, i.e. demonstrating comorbidity was more prevalent than either disorder alone. These findings are in keeping with a national US sample of adolescents (Kilpatrick et al., 2003) and a meta-analysis of the adult trauma literature (Rytwinski et al., 2013), and point to a continued need to address comorbidity when considering reactions to traumatic events in youth.

Correlations of maladaptive cognitive processes

Our second aim assessed the associations of negative cognitive appraisals (trauma-related as measured/defined by the CPTCI-S and depressogenic via the CTI-C), cognitive avoidance and rumination in PTSS and depression symptoms, finding all constructs highly correlated to both symptomologies. Only rumination showed a significantly stronger association in one disorder (depression) over another, highlighting shared cognitive processes. These results support previous findings in the literature implicating these constructs in PTSD (Dunmore et al., 2001; Meiser-Stedman et al., 2009a, 2014) and depression (Braet et al., 2015; Felton et al., 2013), but further the literature in demonstrating equivocal strengths of relationships when PTSS and depression symptoms are concurrently compared. Whilst our results endorse the suggestion that rumination is a transdiagnostic process in PTSS and depression symptoms (Birrer & Michael, 2011; Ehring & Watkins, 2008), the stronger association with depression symptoms compared to PTSS may suggest that rumination plays a somewhat more important role in depression severity.

A noteworthy finding was the similar correlation strengths of depressogenic and trauma-related appraisals, seemingly suggesting little specificity in the content of negative appraisals between PTSS and depression. This is consistent with findings in the adult literature (Gonzalo et al., 2012; Raab et al., 2015). This may be a reflection of both measures of negative appraisals tapping into similar latent constructs; indeed, the correlation between the measures was high ($r = .76$).

Diagnostic group differences

Our third aim explored probable diagnostic group differences in symptomology, negative cognitive appraisals, cognitive avoidance and rumination. All diagnostic groups endorsed levels of all cognitive processes and endorsement was significantly greater than the no diagnosis group, suggesting commonality in the cognitive processes employed. The level of shared symptoms across all cognitive categories is more in line with a shared vulnerability hypothesis of comorbidity rather than distinct categorisation of depression and PTSD with differing or partial overlapping symptomatology (Angelakis & Nixon, 2015). The PTSD only and depression only groups were largely similar except for the depression group's significantly greater endorsement of depression symptoms and rumination. This appears to further highlight the more salient role of rumination in depression in line with our correlational results, but contrasts with Birrer and Michael's (2011) finding of no significant group differences in their adult sample.

Some distinctions were underlined between the single disorders in comparisons to the comorbid group, where the PTSD group showed significantly less endorsement on all measures, but the depression group only significantly differed from the comorbid group on trauma appraisals and PTSD symptoms. Whilst the literature is scarce, similar group patterns were found for negative appraisals in an adult sample, with a combined PTSD-depression group endorsing more depressive attributions than a PTSD-only group (Gonzalo et al., 2012); no difference was found between the PTSD-depression and PTSD-only groups for trauma-related appraisals, however. Whilst these findings might support suggestions of specificity, the commonality of the endorsement of all maladaptive cognitive processes and both PTSS and depression symptoms in all diagnostic groups is more akin to a shared vulnerability hypothesis. Another interpretation could be that the PTSD only group is characteristic of a presentation reflecting a more low-level response, whereas the comorbid group may reflect a presentation of a more severe response involving both more depression symptoms and PTSS. This may support the emerging concept of a single general traumatic stress latent construct (Dekel et al., 2014; Elhai et al., 2011; O'Donnell et al., 2004) with shared cognitive vulnerabilities that may promote broader symptomology to a greater or lesser extent.

Specificity and commonality of cognitive predictors in PTSS and depression symptoms

Our final aim was to explore the specificity and commonality of negative cognitive appraisals, cognitive avoidance and rumination as predictors of PTSS and depression symptoms. The findings from our regression analyses revealed firstly that the cognitive predictors appeared important, explaining a large

(and similar) degree (75-78%) of the variance in models or PTSS and depression symptoms in adolescents; cognitive appraisals explained the majority of this variance. This is largely in line with other studies in the adult and adolescent literature demonstrating firstly the importance of cognitive predictors (Ehring et al., 2006; 2008; Kleim et al., 2012; Meiser-Stedman et al., 2009a), and secondly that maladaptive appraisals may be a particularly important predictor of post-traumatic reactions (e.g. Ponnamperuma & Nicolson, 2016). The present study adds to the current literature by extending these findings in predicting depression symptoms in adolescents, including depressogenic as well as trauma-related appraisals, and finally comparing both PTSS and depression symptoms in the same study. Moreover, our findings stress that many cognitive processes implicated in cognitive models of emotional disorders – i.e. trauma- or depression-related appraisals, avoidance, rumination – have their effect on PTSD and depression in common with each other, rather than accounting for much variance uniquely.

Interestingly, trauma-related appraisals appeared the most important predictor in both PTSS and depression symptoms, suggesting a crucial role in both disorders. This is consistent with the central role of trauma appraisals in models of PTSD (e.g. Ehlers & Clark, 2000); but importantly, it appeared that trauma-related appraisals were also central in depression in trauma-exposed adolescents, even over depressogenic appraisals. This is consistent with research questioning the specificity of trauma appraisals to PTSD (e.g. Gonzalo et al., 2012). We also find support for cognitive avoidance as a shared vulnerability of equivalent magnitude. One interpretation could be that cognitive avoidance may be a response to trauma-related content/intrusions shared in both PTSD and depression.

It is noteworthy that rumination was a non-significant predictor in our regression model of PTSS, unlike other adolescent PTSD studies (e.g. Meiser-Stedman et al., 2014; Michl et al., 2013), and inconsistent with the strong correlations observed in the present data. Commonality analysis was able to further clarify the pathways underlying this. Rumination was shown to contribute negligible *unique* variance in predicting PTSS but contributed greatly to the *common* variance. Thus, rumination appears to play a crucial role in the interplay with the other maladaptive cognitive processes in predicting PTSS. Further research is required to better understand this interplay. Conversely, it is possible that this high common variance was artificially bolstered by the nature of the CSRQ combining items of rumination process and content, the latter being similar to items in the appraisal measures. As such, a measure of pure rumination process may be beneficial in future investigations.

Implications and further research

Our findings suggest that comorbidity should routinely be assessed in adolescents exposed to potentially traumatic events, and that treatment should address PTSD-depression comorbidity as although tailored therapies exist for PTSD and depression respectively the authors are not aware of any evidenced-based integrated PTSD-Depression therapy protocol/guidelines. Furthermore, our finding of comparable levels of PTSS in both the probable depression and PTSD only groups suggests that clinicians should pay specific attention to PTSS in adolescents presenting to services with depression. This is salient in view of suggestions that PTSD is often under-identified and untreated in adolescents, where depression may be more recognised (Gerson & Rappaport, 2013; Havens et al., 2012). Alternatively, our findings may be interpreted in light of the finding from adults that intrusive memories are relatively common experiences in depression (Payne et al., 2019).

Our findings highlight high comorbidity rates and shared underlying cognitive mechanisms, raising questions around the validity and meaningfulness of commonly used categorical diagnostic approaches. These findings are aligned to calls in the literature and emerging models for dimensional approaches to assessment (Kotov et al., 2017; Cuthbert & Insel, 2013; Krueger & Markon, 2006).

Implications for the treatment of both singular disorder presentation and comorbidity are raised. Our findings identify cognitive appraisals, cognitive avoidance and rumination as shared vulnerabilities important in both PTSS and depression symptoms in adolescents. Thus, interventions targeting these cognitive processes, particularly negative appraisals, may be beneficial. Future research might also try to understand the how the cognitive processes investigated here have such strongly overlap in terms of common variance explained.

The finding that trauma-related appraisals were more important than depressogenic appraisals as a predictor of depression symptoms, suggests that current treatments for depression symptoms may benefit from addressing the constructs indexed by trauma-related measures such as the CPTCI-S, i.e. permanent psychological damage and hopelessness around improvement, a sense of psychological aberrance, perceptions of vulnerability and weakness.

Limitations

The findings of the present study should be considered in line with the limitations. The cross-sectional nature and use of lifetime potentially traumatic events means the study is exploratory and causation cannot be

assumed; prospective studies are required to further corroborate these findings.

The probable diagnostic groups were established using thresholds of self-report clinically relevant symptoms rather than based on a structured diagnostic interview, thus probable diagnostic groups were merely indicative, limiting generalisability; this may also explain the relatively high rates of youth endorsing trauma exposure and scoring above cut-off for PTSD and depression. Participants may have endorsed a number of symptoms on the questionnaire but in a structured interview format these may have been found to not be symptoms. We also focused on PTSS and depression symptoms and not other possible psychopathology that may be comorbid with these conditions (e.g. different anxiety disorders). Focusing on a trauma-exposed sample for the present analyses may have meant that trauma-related processes, in particular trauma-related appraisals, had a strong role; for youth without a trauma history, such appraisals may have had less of a strong association with depression. An additional limitation comes from the use of community sampling, in that sample sizes of probable diagnostic cases were naturally small ($N = 11–21$); further research employing larger sample sizes would be needed to draw stronger conclusions. It is also important to note that a wide range of risk factors have been implicated in both PTSD and depression and that the studied predictors are by no means exhaustive.

Conclusion

This study is the first examination of cognitive appraisals, cognitive avoidance and rumination in PTSD and depression simultaneously in an adolescent sample. We found evidence for transdiagnostic maladaptive cognitive processes in PTSD and depression, providing preliminary support for a shared vulnerability hypothesis in explaining the high level of comorbidity between the disorders.

Disclosure statement

No potential conflict of interest was reported by the authors.

Data availability statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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