**ORIGINAL ARTICLE**

# Psychometric Properties of the Portuguese Version of the Child Post-traumatic Cognitions Inventory in a Sample of Children and Adolescents Following a Wildfire Disaster

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**Abstract**

This study aimed to examine the psychometric properties of the Child Post-Traumatic Cognitions Inventory (CPTCI) in a sample of Portuguese children and adolescents, following the exposition to a wildfire disaster. The sample included 533 children and adolescents living in regions exposed to the wildfire disaster (non-clinical sample: $n = 483$; clinical sample: $n = 50$). The short form of the instrument (CPTCI-SF) including two correlated factors ('Sense of Disturbing and Permanent Change' and 'Sense of Being a Fragile Person in a Scary World') showed good model fit and was invariant across gender and age-groups. Good internal consistency ($> .70$) was found, and higher CPTCI scores were associated with poorer adjustment indicators. The clinical sample presented significantly higher CPTCI scores than the non-clinical sample. These results contribute to the cross-cultural validation of the CPTCI and support the adequacy of its short form as a reliable and valid measure to be used with Portuguese children and adolescents.

**Keywords** Child Post-traumatic Cognitions Inventory · Post-traumatic cognitions · PTSD · Psychometric studies · Trauma · Wildfire disaster

## Introduction

Exposure to potentially traumatic events (e.g., natural disasters such as wildfires, violence, war, sexual abuse) constitutes a risk factor for the development of mental illness in children and adolescents, including Post-traumatic Stress Disorder (PTSD) [1]. The rates of traumatic exposure among youth are high, with large, representative studies suggesting that more than two thirds of children and adolescents have been exposed to at least one potentially traumatic event [1–3]. A significant proportion of children and adolescents who are exposed to a traumatic event display initial stress reactions (e.g., symptoms of posttraumatic stress) that can interfere with their overall functioning and wellbeing [2, 4].

Although the initial stress reactions tend to decline over time in most youth [5], some children and adolescents present more complex, intense, chronic and pervasive reactions to the traumatic event, leading to a diagnosis of PTSD. Data from a meta-analysis reported that the incidence of PTSD among trauma-exposed children and adolescents was 15.9% [6], and the associated lifetime prevalence of PTSD was 7.6% [7]. Longitudinal studies show that PTSD symptoms are frequently present during the first 12 months post-disaster [8], with 3.9% to 23.0% of children and adolescents presenting a chronic trajectory of symptoms [9]. PTSD results into considerable functional impairment and, when left untreated, is associated with other psychiatric conditions (e.g., depression, anxiety, substance use, conduct disorder), compromised health and impaired quality of life [1, 10–12].

Cognitive models of PTSD [13, 14], which are also applicable to children and adolescents [15, 16], highlight the prominent role of the individual's appraisals of the traumatic event and of its impact in the maintenance and exacerbation of trauma-related symptoms. Specifically, negative trauma-related cognitions, including the idea that the world is a completely dangerous place and the view of oneself as incompetent [14], contribute to create a sense of "current

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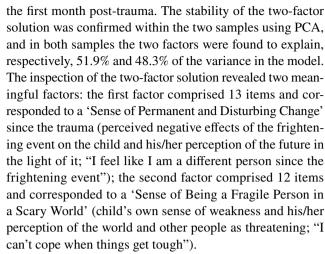[2] Portucalense University, Porto, Portugal

threat" and motivate the use of maladaptive coping strategies (e.g., thought suppression, avoidance, rumination), which will maintain and increase the individual's stress reactions and symptoms [13]. Negative trauma-related cognitions were found to have an important role in the development of PTSD in children and adolescents [15], and two recent meta-analyses found evidence of a strong positive association between trauma-related negative cognitions and PTSD symptoms in children and adolescents, regardless of the type of trauma, time of assessment and selected measures of trauma-related appraisals [17, 18]. Therefore, it is of paramount importance to have developmentally adapted, reliable and valid measures to assess post-traumatic cognitions in children and adolescents.

## Development of the Child Post-traumatic Cognitions Inventory (CPTCI)

The CPTCI was developed by Meiser-Stedman et al. [19] to bridge the existent gap in the assessment of children's negative post-traumatic cognitions. Although other instruments to assess negative automatic cognitions in children and adolescents were available (e.g., Children's Automatic Thoughts Scale; [20]), they failed to capture specific trauma-related appraisals (e.g., sense of being fragile after the event, negative consequences of the traumatic event).

The CPTCI was derived from the Post-traumatic Cognitions Inventory (PTCI; [21]), a 33-item psychometrically robust measure to assess negative trauma-related cognitions in the adult population. The preliminary version of the CPTCI included an initial pool of 41 items mainly derived from age-appropriate adaptations of the 33 items of the adult PTCI, with exception of one item which was found non-suitable for children, and nine additional items specifically developed to better capture the child's negative appraisals of traumatic stress symptoms [19]. The preliminary version of CPTCI was tested in a community sample of 223 children and adolescents (aged 11–18 years), who completed the CPTCI in relation to the most frightening event they had experienced in the previous two months. A principal component analysis (PCA) was performed, and a two-factor solution was found (the factors accounted for 32.9% and 6.2% of variance). Based on the items' loadings on the factors (loadings higher than 0.50 on a given factor and less than 0.40 on the other factor), 25 items were retained for the final version of the questionnaire.

The two-factor solution of the final version of CPTCI was further tested through PCA, in two additional samples: a sample of 138 children and adolescents (who were exposed or witnessed an assault or a motor vehicle accident) assessed at least 6-months post-trauma; and a sample of 209 children and adolescents admitted to hospitals following injury (e.g., motor vehicle accidents, falls) who were assessed within the first month post-trauma. The stability of the two-factor solution was confirmed within the two samples using PCA, and in both samples the two factors were found to explain, respectively, 51.9% and 48.3% of the variance in the model. The inspection of the two-factor solution revealed two meaningful factors: the first factor comprised 13 items and corresponded to a 'Sense of Permanent and Disturbing Change' since the trauma (perceived negative effects of the frightening event on the child and his/her perception of the future in the light of it; "I feel like I am a different person since the frightening event"); the second factor comprised 12 items and corresponded to a 'Sense of Being a Fragile Person in a Scary World' (child's own sense of weakness and his/her perception of the world and other people as threatening; "I can't cope when things get tough").

Concerning the psychometric properties of the final version of CPTCI, appropriate levels of internal consistency (Cronbach's alpha coefficients in the three samples ranged between 0.91 and 0.93 for the factor 'Sense of Permanent and Disturbing Change', and between 0.86 and 0.88 for the factor 'Sense of Being a Fragile Person in a Scary World') and strong test–retest reliability (ranging from 0.76 to 0.78 for the factor 'Sense of Permanent and Disturbing Change', and between 0.70 and 0.72 for the factor 'Sense of Being a Fragile Person in a Scary World') were found. Moreover, CPTCI scores were positively and significantly correlated with the measures used to index post-traumatic stress symptoms and depressive symptoms, suggesting good convergent validity, and were able to discriminate between children with and without a clinical diagnosis of PTSD and between children with and without Acute Stress Disorder, supporting its discriminant validity [19].

## Cross-Cultural Validation of the CPTCI: Adaptation in Different Languages and Psychometric Properties

Since its development, in 2009, the CPTCI has been translated and adapted for use into different languages (e.g., German, Dutch, Taiwanese, Brazilian Portuguese). The psychometric properties of the different versions of CPTCI have been investigated in heterogenous samples, including community samples (participants were instructed to answer considering the most frightening event they experienced; e.g., [22]), clinical samples [23, 24], or both [25].

Regarding the factorial structure of the CPTCI, the original two-factor correlated model was tested in all versions using confirmatory procedures (confirmatory factor analysis; CFA). However, the original two-factor model failed to demonstrate good adjustment indices in the Brazilian [22], German [23], Dutch [25] and the Taiwanese [26] versions. In the Brazilian and Taiwanese versions, the authors proposed new models based on statistical criteria. Concerning the Brazilian version, the authors performed an exploratory factor

analysis after the CFA, which found a two-factor solution similar to the original, but with six of the 25 items loading stronger on a different factor than the original version [22]. In the studies of the Taiwanese version of the instrument, five items of the original version were removed based on modification indices and factor loadings, which significantly improved the model fit [26].

On the other hand, despite presenting adjustment indices below the cutoffs of acceptance, the original two-factor correlated structure was adopted in the German and in the Dutch versions of the CPTCI, as this model performed better in comparison to other models. In the German version, the authors compared the original two-factor correlated model with the unidimensional model and with a bifactorial model (including a general factor and two subordinated factors similar to the ones of the original version). Despite the better adjustment indices of the bifactorial model compared to the two-factor correlated and unidimensional models, nine of the items in the bifactorial model presented small and non-significant loadings on their respective subscales, contradicting the adequacy of a subordinated two-factor structure [23]. Similarly, in the psychometric studies of the Dutch version of CPTCI, the unidimensional and the two-factor correlated models were compared, with the two-factor correlated model presenting better adjustment indices than the unidimensional model, both in the clinical and community samples [25]. Overall, the reduced support for the original two-factor correlated model found in the studies, which may be related with the heterogeneity of sample characteristics and cultural differences [27], suggest the need to better investigate the factorial structure of the CPTCI, in order to clarify its construct validity.

Despite the inconsistent findings concerning its factorial structure, the psychometric studies conducted with the different versions of the CPTCI found evidence that supports its good internal consistency (Cronbach's alphas $\geq 0.78$), convergent validity (strong and positive correlations between CPTCI scores and measures of post-traumatic stress symptoms, depression and anxiety), and discriminant validity in differentiating children and adolescents with and without a clinical diagnosis of PTSD [22, 23, 25, 26].

Considering that CPTCI is a promising questionnaire to measure negative post-traumatic cognitions in children and adolescents, a short-form of the CPTCI was developed to facilitate its application in clinical settings, based in the original version of the scale [24]. Using a sample of 492 children and adolescents from three different locations (East Anglia, London and Australia) that were exposed to a traumatic event in the last six months, and who answered to the original version of the CPTCI, the authors performed preliminary analyses to identify the items that should be retained in the short form of the CPTCI. The 10 items that were selected to compose the CPTCI-SF performed better

in all three criteria: strong item-total correlations ($r \geq 0.72$), strong correlations with PTSD status ($r \geq 0.49$), and high factor loadings (at or above 0.77). The two-factor corelated model of the short version included the same two dimensions than the original version ('Sense of Permanent and Disturbing Change', 6 items; and 'Sense of Being a Fragile Person in a Scary World', 4 items) and showed and excellent fit to the data, with factor loadings ranging from 0.64 to 0.79, as well as good internal consistency (Cronbach alphas $\geq 0.81$) [24]. To our knowledge, the two-factor structure of the CPTCI-SF was only examined in one study conducted with 237 Korean children and adolescents exposed to sexual violence. The two-factor structure for the short form of the instrument globally showed good adjustment indices and performed better than the unidimensional model [27].

## The Present Study

In the summer of 2017, the central region of Portugal was exposed to large wildfires with a devastating impact and losses (human and material losses) to all the community, including its children and adolescents. Although the rates of exposure to community-wide natural disasters are usually lower than for other traumatic events, this type of traumatic event typically results in large proportion of children and adolescent affected [28]. Therefore, it is of paramount importance to have developmentally-appropriate and valid measures to assess clinically relevant constructs, such as trauma-related cognitions. Taking this into account, the present study aimed to contribute to the cross-cultural validation of the CPTCI in a different culture—the Portuguese culture—, by adapting and examining the psychometric properties of the questionnaire in a sample of Portuguese children and adolescents living in the regions that were exposed to the summer wildfires.

The first aim of this study was to examine the factor structure of the Portuguese version of the CPTCI. Specifically, we aimed to test and compare the original two-factor solution with other competing models identified in the psychometric studies of the translated versions of CPTCI: the modified 25-item two-factor correlated model [22]; the 20-item two-factor correlated model [26]; the unidimensional model [23, 25]; and the bifactorial model [23]. Moreover, we aimed to examine the adequacy of the short form of the CPTCI (CPTCI-SF) [24] in the Portuguese population. Given the inconsistent findings of prior studies, no hypotheses were established concerning the factor structure of the Portuguese version of CPTCI, although based on a prior study [27] we expect that the short form of the questionnaire results into a good fit to the data. The second aim of this study was to examine the CPTCI's reliability, namely considering its

internal consistency. Good internal consistency values were expected.

The third aim of this study was to examine the questionnaire measurement invariance as a function of gender and age-group (including children [8–10 years], early adolescents [11–13 years] and late adolescents [14–17 years]; [29]), as well as gender and age-group differences concerning levels of negative post-traumatic cognitions. Although some studies found that girls scored higher on CPTCI scores compared to boys [19, 25], other studies found no evidence of gender differences [22]. Moreover, although most of the studies found no age-group differences on CPTCI scores [19, 22, 25], Lee et al. [27] found that late adolescents presented higher CPTCI scores. Based on prior studies, no specific hypotheses were established concerning gender and age-group mean differences. The CPTCI was expected to be gender and age invariant.
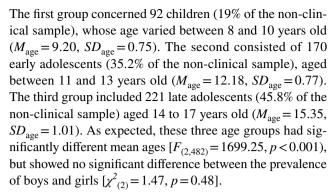
The fourth aim of this study was to examine the scale's validity evidence in relation to external variables. On the one hand, the associations between CPTCI scores and other measures expected to be associated with the construct assessed by CPTCI (negative post-traumatic appraisals or cognitions) were examined. Based on prior studies [19, 23, 25, 27], a positive association between negative post-traumatic cognitions, internalizing and externalizing symptoms and maladaptive emotion regulation strategies (e.g., suppression), as well as a negative association between negative post-traumatic cognitions and quality of life were expected. On the other hand, CPTCI scores of children and adolescents with and without a clinical diagnosis of PTSD were compared, to ascertain the ability of CPTCI scores to differentiate between clinical and non-clinical samples. Congruently with other studies [19, 23, 25], significantly higher CPTCI scores among children and adolescents with a clinical diagnosis of PTSD were expected.

## Method

### Participants

The non-clinical sample (i.e., children and adolescents without a clinical diagnosis of a psychopathological condition associated with the exposure to a traumatic event) included 483 participants aged between 8 and 17 years old ($M = 13.06$, $SD = 2.51$), of which 258 were boys (53.4%) and 225 were girls (46.6%); boys and girls had similar mean ages [$t_{(481)} = 1.24$, $p = 0.22$]. The majority of these participants lived with their nuclear family ($n = 479$, 99.2%) and had never been retained in the same school year before ($n = 425$, 88%).

Participants from the non-clinical sample were divided into three age groups so that such groups could be compared.

The first group concerned 92 children (19% of the non-clinical sample), whose age varied between 8 and 10 years old ($M_{age} = 9.20$, $SD_{age} = 0.75$). The second consisted of 170 early adolescents (35.2% of the non-clinical sample), aged between 11 and 13 years old ($M_{age} = 12.18$, $SD_{age} = 0.77$). The third group included 221 late adolescents (45.8% of the non-clinical sample) aged 14 to 17 years old ($M_{age} = 15.35$, $SD_{age} = 1.01$). As expected, these three age groups had significantly different mean ages [$F_{(2,482)} = 1699.25$, $p < 0.001$], but showed no significant difference between the prevalence of boys and girls [$\chi^2_{(2)} = 1.47$, $p = 0.48$].

An additional sample of 50 participants who received a diagnosis of a psychopathological condition associated with the exposure to a traumatic event were selected so that validity in relation to an external criteria could be assessed (i.e., clinical sample). They were 8 boys (16.0%) and 42 girls (84.0%); so, girls were significantly overrepresented in this sample, in comparison with the complete sample [$\chi^2_{(1)} = 25.37$, $p < 0.001$]. Also, participants in the clinical sample were significantly younger ($M_{age} = 12.00$, $SD_{age} = 2.62$) than participants in the non-clinical sample [$t_{(531)} = 2.84$, $p = 0.005$]. Most of the clinical sample had a diagnosis of PTSD ($n = 26$, 52.0%) or a diagnosis of PTSD with comorbid disorders ($n = 13$, 26.0%), while other diagnoses (e.g., grief, separation anxiety disorder) occurred in 22.0% of cases ($n = 11$).

### Procedure

This study is part of the project "Pinhal de Futuro: The prevalence of trauma related disorders in children and adolescents affected by forest fires and impact of psychological interventions on their recovery". The project aimed to assess the prevalence of trauma-related disorders in children and adolescents (aged 6 to 18 years old) living in the Portuguese regions affected by wildfires during the summer of 2017 (June and October), and to provide evidence-based psychological intervention to children/adolescents in need of psychological treatment. The project had a nine-month implementation, starting in January 2018. Children and adolescents from six municipalities from the central region of Portugal were included in the project: Figueiró dos Vinhos, Castanheira de Pêra, Pedrógão Grande, Pampilhosa da Serra, Góis and Sertã. The planning and implementation of the project took place in accordance with the ethical recommendations of the American Psychological Association [30], and of the World Medical Association's Declaration of Helsinki [31]. The project was approved by the Ethics Committee of the Faculty of Psychology and Educational Sciences—University of Coimbra, and submitted to the Portuguese Data Protection Authority. Concerning data collection, informed consent (or informal assent, for children under 14 years old) was obtained from children and adolescents and their

legal representative (under 18 years). The consent contained information about the project goals, the participants' and researchers' roles.

The data reported in this study refers to the first phase of the project (screening and assessment). Children and adolescents aged 6 to 18 years living in the municipalities covered by the project were screened for the presence of signs of trauma- and stressor-related disorders (including PTSD, adjustment disorder), separation anxiety disorder, bereavement, or other difficulties that can be or not directly related with the traumatic event (e.g., attention deficit and hyperactive symptoms, drop in school performance, regressive symptoms). Data collection occurred at schools. Of the 2557 children attending the schools of the municipalities included in the project, 1828 (94.5%) completed the screening procedure. The screenings was performed by seven trained clinical psychologists, using a computerized screening tool specifically developed for this project, which was based on the diagnostic criteria of DSM-5 [32] and on the M.I.N.I. Kid (Mini International Neuropsychiatric Interview for Children and Adolescents; [33]). Of the screened children, 465 (25.4%) had a positive screen, of which 264 (14.4% of the screened sample) had a positive screen for trauma- and stressor-related disorders, separation anxiety disorder or bereavement. Children and adolescents with a positive screen result were further assessed with the M.I.N.I. Kid [33] to confirm the clinical diagnosis. 86 children and adolescents had a confirmed diagnosis of a psychopathological condition associated with the exposure to a traumatic event, of which 70 received psychological treatment within the context of the project (the remaining 16 were already receiving psychological/psychiatric treatment or did not consent treatment).

The non-clinical sample was composed of children and adolescents that had a negative screen in the screening assessment, while the clinical sample was composed of children and adolescents with a confirmed diagnosis of a psychopathological condition associated with the exposure to a traumatic event. After the screening, part of the non-clinical sample ($n=483$; which was selected based on convenience criteria, such as availability of class time on a given discipline to fulfill the questionnaires) were invited to fill an assessment protocol including different self-report questionnaires. The participants completed the assessment protocol during a class, after authorization of the responsible teacher, and in the presence of the clinical psychologist (research assistant) to clarify any questions. For the clinical sample ($n=50$; of the 70 children/adolescents receiving psychological treatment within the context of the project, 20 of them initiated the intervention protocol before the assessment, so only 50 of them were assessed previously to receiving

any kind of intervention), the participants answered to the assessment protocol before starting the individual psychological intervention process. Data collection occurred between May, 2018 and June, 2018.

## Measures

### Demographic Questionnaire

All participants completed a self-report form that included questions assessing age, gender, household, school year and number of school year retentions.

### Child Post-traumatic Cognitions Inventory

The CPTCI was developed to assess children's negative post-traumatic cognitions. The original version of the CPTCI [19] is comprised of 25 items, organized into two subscales: (1) Sense of Permanent and Disturbing Change since the Trauma (CPTCI-PC; 13 items; "My reactions since the frightening event mean I will never get over it"); and (2) Sense of Being a Fragile Person in a Scary World (CPTCI-SW; 12 items; "I can't stop bad things from happening to me"). The CPTCI items are answered using a 4-item scale that ranges from 1 (*Don't agree at all*) to 4 (*Agree a lot*). It is possible to compute the subscale scores by summing the items that compose the subscales. Higher scores were indicative of higher levels of negative of post-traumatic cognitions.

The Portuguese version of CPTCI was developed through a forward–backward translation procedure. The authorization from the authors of the original version was asked to translate and validate the questionnaire to European Portuguese language. First, the items of the questionnaire were independently translated by two of the researchers fluent in Portuguese and English and familiar with terminology of the area covered by the questionnaire. The two translated versions were compared and discussed to obtain the first Portuguese version of the CPTCI. The preliminary Portuguese version was back-translated into English by a native English-speaker. The original and the back-translated versions were compared, and translation disparities were resolved to obtain the final Portuguese version of the CPTCI, which was used in the present study.

### KidScreen-10

The KIDSCREEN-10 index [34, 35] aims to assess the children's perception of their quality of life. The KIDSCREEN-10 is an unidimensional scale comprising ten

items (e.g., "Have you felt fit and well?"), answered with a 5-point scale ranging from 1 (*never; not at all*) to 5 (*always; extremely*). The total score is computed by the sum of the items, and higher scores are indicative of higher quality of life. The original version of the KIDSCREEN-10 index [35], as well as the Portuguese adapted version [34] have shown adequate reliability and validity of the scale. The measure achieved an internal consistency value of 0.77 in the current non-clinical sample.

## Emotion Regulation Questionnaire for Children and Adolescents

The Emotion Regulation Questionnaire for Children and Adolescents (ERQ-CA; [36, 37]) comprises 10 items aiming to assess two strategies of emotion regulation in children and adolescents: (1) Cognitive Reappraisal (6 items; e.g., "When I'm worried about something, I make myself think about it in way that helps me feel better"); and (2) Expressive Suppression (4 items; e.g., "I keep my feelings to myself"). Items are answered on a 5-point Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). The subscale scores can be computed by summing the items that compose each subscale. Higher scores on each subscale are indicative of greater use of the corresponding emotion regulation strategy. The original [36] and the Portuguese [37] versions of the instrument showed good psychometric properties. In the current study, adequate internal consistency values were found for the Cognitive Reappraisal (i.e., 0.71) and Expressive Suppression (i.e., 0.69) measures using the current non-clinical sample.

## Strengths and Difficulties Questionnaire

The self-report version of the Strengths and Difficulties Questionnaire (SDQ; [38]) was used to assess the prosocial behavior and psychological functioning of children and adolescents. The SDQ is comprised of 25 items, answered using a Likert-type response scale, ranging from 0 (*not true*) to 2 (*certainly true*), and organized into five scales with five items each: Emotional Symptoms, Conduct Problems, Hyperactivity/Inattention, Peer Relationship Problems and Prosocial Behavior. Apart from the Prosocial Behavior scale (e.g., "I try to be nice to other people. I care about their feelings"), and following recent recommendations for assessing low-risk or general population samples, the remaining items were coded into Internalizing (e.g. "I worry a lot") and Externalizing Problems (e.g., "I get very angry and often lose my temper") [39]. Mean scores were computed for each scale, and higher scores indicate

more internalizing/externalizing problems and high levels of prosocial behavior. The original version of the SDQ has shown good psychometric properties [38]. In a study using a large representative sample of 18.222 British children/adolescents (5–16 years old), the second-order internalizing (emotional plus peer items) and externalizing (behavioral plus hyperactivity items) shown a good model fit through confirmatory analyses, as well as evidence of good convergent and discriminant validity and acceptable reliability [39]. Adequate psychometric properties were also found in other studies using the second order internalizing and externalizing factors within the Portuguese population [40, 41]. In the current study, the three subscales achieved adequate internal consistency values (Prosocial Behavior: $\alpha = 0.67$; Internalizing Problems: $\alpha = 0.62$; Externalizing Problems: $\alpha = 0.73$).

## Data Analysis

Preliminary analyses to characterize the sample, the study variables and the pattern of missingness were conducted with the Statistical Package for the Social Sciences (IBMS SPSS Statistics, version 21.0).

As described earlier, there have been several different proposals as to what might be the CPTCI's internal structure; these different proposals have seldom been compared amongst each other. So, in the current work, we tested the different previously proposed measurement models of the CPTCI, via confirmatory factor analyses (CFA). Each model's fit was judged based on the two-index approach proposed by Hu and Bentler [42]. Specifically, for the model to be considered an acceptable fit for the data, a Standardized Root Mean Square Residual (SRMR) value ≤ 0.09 combined with either a Comparative Fit Index (CFI) value ≥ 0.95 or a Root Mean Square Error of Approximation value ≤ 0.06. Additionally, the models were compared amongst themselves, such that models presenting lower SRMR, RMSEA and Akaike Information Criteria values in addition to higher CFI values were considered a better relative fit to the data.

The model that achieved acceptable fit and the best relative fit was then subjected to multi-group analyses in order to ascertain for gender-based and age-based measurement invariance. We tested for three levels for invariance, which are considered necessary for between-group comparisons to be considered reliable: (1) configural invariance, by running a multiple group analysis without any equality constrains; (2) metric invariance, where the factor loadings are held equal across groups, and (3) scalar invariance, where both factor loadings and item intercepts are held equal across

groups [43]. Comparison of successive models, and subsequent conclusions on invariance, was made based on the guidelines provided by Chen [44]: ΔCFI ≤ -0.01 combined with ΔRMSEA ≤ 0.015 or with ΔSRMR ≤ 0.03/01 for metric and scalar invariance, respectively. Following strong measurement invariance, latent mean comparisons (as proposed by Dimitrov [45]) were performed between gender and age groups. CFA and multi-group analyses were conducted using MPlus v7.4 [46].

Because the data was not multivariate normal (cf. Results section), the internal consistency of the measures taken from the best fitting model was considered based on the ordinal version of the Cronbach alpha as proposed by Gaderman, Guhn, and Zumbo [47]; these analyses were calculated using the R software. Finally, non-parametric correlation analyses using the IBM SPSS Statistics v.21 were carried out to explore the associations between the measures taken from the best fitting model and external variables (i.e., mental health, emotion regulation, prosocial behavior, and internalizing and externalizing problems). To compare the non-clinical and clinical sample concerning CPTCI scores, controlling for gender and age (as both groups differed in such variables), a multivariate analysis of covariance was performed, followed by univariate tests if the effect was significant. The option for parametric rather non-parametric tests was due to the impossibility of controlling for covariates with non-parametric tests, and to the robustness of analysis of variance to the violation of normality assumption [48].

# Results

## Preliminary Analyses

Of the non-clinical sample, 22 participants presented with between 1 to 3 missing values, which represented 4.56% of the cases and 0.23% of the potential response pool. These values were missing completely at random [MCAR $\chi^2_{(402)} = 397.38$, $p = 0.56$]. Under these circumstances, missing values were dealt with via expected maximization imputation. Furthermore, the data was found not to be multivariate normal (Mardia's skewness = 154.77, $p < 0.001$ and Mardia's kurtosis = 997.18, $p < 0.001$), which lead to using the Maximum Likelihood Robust estimator and non-parametric tests, as appropriate.

## Measurement Model of the CPTCI

The fit indicators for all seven models under scrutiny are shown in Table 1. Only models E (i.e., bifactorial model),

F (i.e., 10 items in two factors) and G (i.e., 10 items in one factor) achieved acceptable fit indicators. Model E had a notably higher AIC, RMSEA and SRMR value, and a lower CFI value, which may also be related to its higher complexity in relation to models F and G. Nevertheless, and similarly to what has been previously reported for this model [23], the loading values of items on the specific factors were very low (i.e., λ ranging from − 0.04 to 0.40 for 'Disturbing and Permanent Change' and λ varying between − 0.05 and 0.49 for 'Sense of Being a Fragile Person in a Scary World'). So, the uniqueness of these factors seems to be lost on the total factor, which, in itself, fitted the worst to the current data (i.e. Model A). This led us to drop the bifactorial model.

As for models F and G, and because there is no notable statistical difference between them, we opted for model F because it may more informative (i.e., it considers two correlated factors similar to the original structure; $r = 0.99$, $p < 0.001$) than model G. The first factor—'Disturbing and Permanent Change'—had loading values varying between 0.71 and 0.75, all significant at $p < 0.001$, an average extracted variance (AVE) of 0.53, and an internal consistency value of $\alpha = 0.93$. The second factor—'Sense of Being a Fragile Person in a Scary World'—had loading values varying between 0.32 and 0.68, all significant at $p < 0.001$, an AVE of 0.29, and an internal consistency value of $\alpha = 0.71$.

## Measurement Invariance Analyses

The unrestrictive model (i.e., allowing all parameters to be freely estimated across groups) was a good fit for combined data of boys and girls; so, configural invariance by gender can be established. The difference in the CFI, RMSEA and SRMR indices as successive equality constraints are placed upon the data further indicate full metric (ΔCFI = 0.002, ΔRMSEA = − 0.004, ΔSRMR = 0.0012) and scalar (ΔCFI = − 0.003, ΔRMSEA = − 0.001, ΔSRMR = − 0.002; cf. Table 1) invariance. This model was also considered to hold for configural invariance by age-groups, given the same criteria. Full metric invariance as also established by age groups (ΔCFI = 0.003, ΔRMSEA = − 0.005, ΔSRMR = 0.018), but only partial scalar invariance, after allowing the intercept of one item ("Bad things always happen", item 15 in the original version, belonging to factor 2) to be variant across groups (ΔCFI = − 0.005, ΔRMSEA = 0.000, ΔSRMR = 0.003; cf. Table 1).

**Table 1** Fit indicators for measurement model and measurement invariance analyses

| | $\chi^2$ | df | RMSEA | 90% CI | CFI | SRMR | AIC |
|---|---|---|---|---|---|---|---|
| Measurement model | | | | | | | |
| A: 25 items in one factor | 743.61 | 275 | .059 | .054; .065 | .865 | .056 | 25,096.27 |
| B: 25 items in two factors | 700.36 | 274 | .057 | .052; .062 | .877 | .054 | 25,032.57 |
| C: 25 items in two factors | 698.43 | 274 | .057 | .051; .062 | .878 | .054 | 25,029.43 |
| D: 20 items in two factors | 408.18 | 169 | .054 | .047; .061 | .907 | .047 | 19,897.21 |
| E: Bifactor model | 511.96 | 250 | .047 | .041; .052 | .925 | .044 | 24,790.87 |
| F: 10 items in two factors | 57.16* | 34 | .038 | .019; .054 | .976 | .032 | 9437.32 |
| G: 10 items in one factor | 57.41* | 35 | .036 | .018; .053 | .977 | .032 | 9435.41 |
| Gender-based measurement invariance | | | | | | | |
| Unrestrictive model | 127.75 | 68 | .060 | .044; .076 | .942 | .047 | 9426.86 |
| Loading invariant model | 133.84 | 76 | .056 | .040; .072 | .944 | .059 | 9425.71 |
| Loading and intercept invariant model | 144.43 | 84 | .055 | .039; .069 | .941 | .057 | 9418.29 |
| Age-based measurement invariance | | | | | | | |
| Late Adolescents | 50.33* | 34 | .047 | .013; .072 | .966 | .036 | 4191.33 |
| Unrestrictive model | 154.15* | 102 | .056 | .037; .074 | .952 | .047 | 9336.15 |
| Loading invariant model | 167.67* | 118 | .051 | .032; .068 | .955 | .065 | 9328.67 |
| Loading and intercept invariant model | 202.61 | 134 | .056 | .040; .072 | .937 | .075 | 9337.81 |
| Loading invariant and partial intercept invariant model | 186.90* | 132 | .051 | .033; .067 | .950 | .068 | 9319.59 |

The $\chi^2$ values were always significant at $p < .001$, unless stated otherwise

df degrees of freedom, RMSEA root mean square error of approximation, 90% CI 90% confidence interval for RMSEA. A: one-factor model comprising the 25 items. B: original model proposed by Meiser-Stedman et al., 2009 that divides 25 items into a 'Disturbing and Permanent Change' factor and a 'Sense of Being a Fragile Person in a Scary World' factor. C: model found using a Brazilian sample [22] that considers the same two factors as model A, but proposing a different constitution for each one of them. D: model found using a Thailand's sample [26] that divides 20 items into the same originally proposed two-factors (cf. Model B). E: Bifactorial model considering the two original factors (cf. Model B) plus one factor considering all 25 items. F: Short two-factor model that uses 10 items to evaluate the two originally proposes factors (cf. Model B). G: Short one-factor model that considers 10 items as loading onto a single total factor

*$p < .01$

## Latent Mean Comparisons

Based on strong measurement invariance by sex, we proceeded with latent mean comparisons across boys and girls, who differed significantly for the 'Disturbing and Permanent Change' factor ($p = 0.014$), with girls presenting lower results (i.e., latent mean for boys = 0.000 and latent mean for girls = − 0.317). Table 2 shows the observed mean and standard deviation values of both factors for the complete sample and by groups. Related to age, children (latent mean = 0.000) scored significantly higher in the 'Disturbing and Permanent Change' factor than both early adolescents (latent mean = − 0.448, $p = 0.017$) and late adolescents (latent mean = − 0.407, $p = 0.017$). Children (latent mean = 0.000) also significantly differed in the same direction from early adolescents (latent mean = − 0.555, $p = 0.013$) but not from late adolescents in the 'Sense of Being a Fragile Person in a Scary World' factor. Alternatively, early and late adolescents had similar scores for both factors.

**Table 2** Observed mean and standard deviation values for the complete sample, by sex and by age-groups

| | Non-clinical sample | | | | | | Clinical sample |
|---|---|---|---|---|---|---|---|
| | Total sample | Boys | Girls | Children | Early adolescents | Middle adolescents | |
| | M (SD) | M (SD) | M (SD) | M (SD) | M (SD) | M (SD) | M (SD) |
| Factor 1 | 8.39 (3.38) | 8.80 (3.66) | 7.94 (2.98) | 9.44 (3.99) | 8.09 (3.14) | 8.20 (3.21) | 12.58 (4.44) |
| Factor 2 | 6.83 (2.32) | 6.85 (2.28) | 6.82 (2.36) | 7.07 (2.46) | 6.42 (2.04) | 7.06 (2.43) | 8.78 (2.87) |

Factor 1 = 'Disturbing and Permanent Change'. Factor 2 = 'Sense of Being a Fragile Person in a Scary World'

**Table 3** Correlation values with other variables

| | KidScreen | Cognitive reappraisal | Expressive suppression | Prosocial behavior | Internalizing problems | External-izing problems |
|---|---|---|---|---|---|---|
| Factor 1 | − .394*** | .01 [ns] | .25*** | − .18*** | .44*** | .41*** |
| Factor 2 | − .42*** | − .02 [ns] | .25**[*] | − .10* | .47*** | .36*** |

Factor 1 = 'Disturbing and Permanent Change'. Factor 2 = 'Sense of Being a Fragile Person in a Scary World'

***$p < .001$, **$p < .01$. , *ns* non-significant

## Validity Evidence in Relation to External Variables

Both factors taken from the short version of the CPTCI correlated similarly with external variables, namely, a significant negative association with quality of life (via KidScreen) and Prosocial Behavior, and significant positive associations with Expressive Suppression and Internalizing and Externalizing Problems; none of the factors correlated significantly with Cognitive Reappraisal (cf. Table 3).

Furthermore, even after controlling for sex and age, participants from the clinical sample presented with significantly different scores in negative post-traumatic cognitions (Wilk's Lambda = 0.89, $F_{2518} = 32.61$, $p < 0.001$, $\eta^2 = 0.112$). Univariate tests show that differences occur both for the 'Disturbing and Permanent Change' factor ($F = 65.24$, $p < 0.001$, $\eta^2 = 0.112$) and for the 'Sense of Being a Fragile Person in a Scary World' factor ($F = 30.44$, $p < 0.001$, $\eta^2 = 0.055$).

## Discussion

The results of the present study represent an important contribution to the cross-cultural validation of the CPTCI, by examining the psychometric properties of the Portuguese version of the scale, and supporting the use of the short form of the CPTCI as a developmentally adapted, reliable and valid measure to assess post-traumatic negative cognitions in Portuguese children and adolescents.

The main goal of the present study was to examine the factor structure of the Portuguese version of the CPTCI. As the original two-factor correlated solution proposed by the authors of the CPTCI [19] was not confirmed in other studies using the questionnaire (e.g., with Brazilian, German, Dutch samples; [22, 23, 25]), different measurement models that have been previously proposed were investigated, to better define the internal structure of the CPTCI. Alike previous research [23], and using the complete set of items of the questionnaire, the only acceptable model was the bifactorial model. However, and similar to what was found in the other study in which such model was examined [23], the bifactorial model showed very low item loadings in the

specific factors, which is suggestive of complex relationships between a uni- and a multidimensional view of the construct. In fact, the poor loadings of the items on their respective factors may be suggestive of the poor factor determinacy (uniqueness) of the specific factors in relation to the general factor. However, the unidimensional model (including only a general factor) failed to prove an adequate model fit both in the German [23] and Dutch [25] versions of the CPTCI, as well as in ours, suggesting that it is not an adequate representation of the internal structure of the CPTCI. Alternatively, and using a reduced set of items as proposed in the short form of the instrument [24], both the one-factor and the two-factor models presented a good fit for the data. These findings are in line with the results of Lee et al. [27], which also found support for the adequacy of the short form of the CPTCI (CPTCI-SF).

Considering that both the unidimensional and the two-factor models of the CPTCI-SF presented an identical adjustment to the data, the two-factor solution was maintained, as proposed by the authors of the short version [24], given its increased informative value about two types of post-traumatic cognitions (respectively, one more related with the child's perceived impact of the frightening event on him/her, and other more related with the child's own sense of weakness) and to better allow the comparison of our results with the ones found with other studies using the same scale [24, 27]. However, the results also showed that despite all items loaded significantly on their respective factor, the item loadings of the first factor were higher than the item loadings of the second factor, as well as the explained variance of the first factor in comparison with the explained variance with the second factor. These results, together with the high correlation found between factors, are suggestive of a higher relative weight of the first factor—'Disturbing and Permanent Change'—in accounting for the total explained variance. In fact, these results are in line with the results found in the study of the development of the original version of the instrument, in which the first factor accounted for more than 30% of the explained variance, while the second factor contributed to explain only six percent of additional variance [19]. In the present study, however, the proportion of average variance extracted is more parsimoniously distributed in both factors.

The Portuguese version of the CPTCI-SF proved to be a reliable measure of negative post-traumatic cognitions, showing good to excellent internal consistency. These results are in line with the results obtained in the original [19] and in the psychometric studies performed with other versions of the complete scale [22, 23, 25], as well as with its short form [24].

To our knowledge, this study was the first to examine the measurement invariance of the scale, as a function of gender and age. Because measurement invariance was found for the two-factor measurement model of the CPTIC-SF based on gender and age groups, it is possible to compare the scale scores as a function of gender (girls vs. boys) and age groups (children vs. early adolescents vs. late adolescents), and to attribute existing differences to actual group differences. In fact, in this study, latent mean differences across gender and age groups were explored. Concerning gender differences, the results showed that, in comparison to boys, girls had lower mean scores in the dimension 'Disturbing and Permanent Change', although no significant differences were found in the dimension 'Sense of Being a Fragile Person in a Scary World'. These results are inconsistent with prior research exploring such differences, which found opposite results (i.e., girls showing higher CPTCI scores; [19, 25]) or no gender differences [22]. Interestingly, the original study of Meiser-Stedman et al. [19] found gender differences in the 'Sense of Being a Fragile Person in a Scary World', but not in the 'Disturbing and Permanent Change' subscale. One possible explanation for these differences is the distinctive nature of the samples and of the potential traumatic event they have experienced. While the sample of this study targets children and adolescents who have been potentially exposed to the same traumatic event (a wildfire that affected the Centre Region of Portugal) but who did not develop a PTSD, in the other samples there was great heterogeneity in terms of types of events considered and time elapsed since the traumatic event. Specifically, in the studies of Meiser-Stedman et al. [19] and of Diehle et al. [25] gender differences were examined within the combined sample which included children and adolescents from the community (who were asked concerning the most frightening event they had experienced, including events such as the death of a loved one but also other events such as divorce/fights between parents or being teased by a colleague [25]) and children and adolescents with a clinical diagnosis of PTSD after exposure to a traumatic event (e.g., sexual abuse, traumatic loss, motor vehicle accident, injury). Congruently, Meiser-Stedman et al. [19] state that children and adolescents who are exposed to a more enduring and devastating traumatic stressor, such as a natural disaster, may appraise their experiences in a different way, considering the wider community impact. Further studies should investigate whether gender differences may be related with the type of traumatic event experienced.

Concerning age, children seem to be more prone to experience both a higher sense of 'Disturbing and Permanent Change' and of 'Being a Fragile Person in a Scary World', in comparison to adolescents. Early and late adolescents seem to hold similar experiences concerning negative post-traumatic cognitions. The results found in our study are not in line with the prior research which found no age-group differences in terms of post-traumatic cognitions [19, 22, 25]. As for gender, the heterogeneity in the samples may have contributed to explain such different results. Moreover, given their varying levels of physical, cognitive, emotional and social development, it is possible that young children experience trauma in a different way than older children or adolescents, as they may have not yet developed the cognitive capacity to make complex appraisals of the traumatic event [49]. Taken into account the wider impact of the traumatic event (wildfire) in the community, and the reduced ability to understand the complex reasons and factors that led to its occurrence, children may have experienced the traumatic event as more devastating and uncontrollable than adolescents, which may have contributed to the development of more negative post-traumatic appraisals. This hypothesis should, however, be further investigated.

Finally, our results provide validity evidence of the CPTCI-SF in relation to external variables. Specifically, the more the children perceive a sense of Disturbing and Permanent Change or of Being a Fragile Person in a Scary World, the more they report poorer quality life and a lower engaging in prosocial behaviors, and the more they report maladjustment outcomes such as suppression of emotional experiences and internalizing and externalizing problems. Moreover, children and adolescents from the clinical sample have shown higher scores in both factors than children and adolescents of the non-clinical sample. These results are in line with prior studies who found significant associations between CPTCI scores and measures of internalizing (e.g., depression and anxiety symptoms) and PTSD symptoms [19, 23, 25], and are also supportive of the strong association between post-traumatic negative cognitions, the use of maladaptive coping strategies (e.g., emotional suppression) [15], and the symptoms of PTSD [17, 18].

Although the current findings are promising, there are also some noteworthy limitations to the current study. Foremost, the sample size was, overall, small, particularly in what concerns gender and age groups, which made it impossible to examine configural invariance by considering each group separately, as proposed by some authors [50]. Moreover, the sample size of the clinical sample is small, and not completely comparable to the non-clinical sample in terms of socio-demographic profile. Another limitation is that this study focuses on one specific potentially traumatic event (natural disaster-wildfire), so the findings of the present study may not be generalizable to groups exposed to

other types of potentially traumatic events. It is important to note, however, that this can be also a strength of this study in comparison with others performed with the same scale, as it addresses the heterogeneity [27] of prior samples who lead to some inconsistent results and less theoretical sound results, namely in what concerns the factor structure of the scale. Finally, test–retest reliability was not examined in the present study.

## Summary

This study represents an important contribution to the measurement of negative post-traumatic related cognitions in children and adolescents, and specifically to the cross-cultural validation of the CPTCI, by showing the adequacy of its short form as a reliable and valid measure to be used with Portuguese children and adolescents, both in clinical practice and research. The Portuguese version of CPTCI-SF comprised a two-factor solution ('Disturbing and Permanent Change' and 'Being a Fragile Person in a Scary World') similar to the one proposed by the authors of the short version. The availability of a specific instrument to assess post-traumatic cognitions is of particular relevance not only to broaden the research on the topic of cognitive appraisals of trauma in children and adolescents, but also because it allows the use of this construct as an indicator of therapeutic change, as negative trauma-related cognitions are important targets of cognitive-behavioral treatment protocols for PTSD in children and adolescents [51].

## Compliance with Ethical Standards

**Conflict of interest** The authors declare that they have no conflict of interest.

**Ethical Approval** All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

**Informed Consent** Informed consent was obtained from all individual participants included in the study.

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