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State versus Trait: Validating State Assessment of Child and Parental Catastrophic Thinking about Children's Acute Pain

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Abstract

Pain catastrophizing has emerged as one of the most robust predictors of child pain outcomes. Although assessments of state (i.e., situation-specific) pain catastrophizing in children and parents are often used, their psychometric properties are unknown. This study aimed to assess factor structure, reliability and predictive validity of state versions of Pain Catastrophizing Scales for children (PCS-C State) and parents (PCS-P State) relative to corresponding trait versions for child and parental pain-related outcomes. Data were pooled from 8 experimental pain studies wherein child and/or parent state catastrophizing (measured immediately before application of a pain stimulus) and trait catastrophizing were assessed in community-based samples of children aged 8–18 years (*N*=689) and their parents (*N*=888) in Dutch or English. Exploratory factor analyses were conducted to examine the underlying factor structure of the PCS-P/PCS-C State, revealing a single factor solution that explained 55.53% of the variance for children and 49.72% for parents. Hierarchical linear regression analyses were used to examine relative influence of state versus trait catastrophizing on child and parent pain-related outcomes. Child and parent state catastrophizing were significantly associated with child pain intensity, child state anxiety and parental distress. State catastrophizing scores showed stronger associations than trait scores for most outcomes.

Perspective: This article presents the psychometric properties of state pain catastrophizing measures for children and parents. Findings underscore the importance of assessing state pain catastrophizing about acute pain experiences in parents and children, and provide a basis for robust and valid measurement of state pain catastrophizing about child pain.

Keywords: pain catastrophizing; child pain; parents; distress; measurement

Introduction

Pain catastrophizing, defined as "*an exaggerated negative mental set brought to bear during actual or anticipated painful experience*", is a well-established robust risk factor for adverse pain-related outcomes (e.g., pain intensity, disability and psychological distress).[31, 39] Research indicates that individuals catastrophize not only about their own pain, but also about others' pain.[11, 14] This is particularly relevant in child-parent dyads.[14]

Accumulating evidence highlights the importance of the social context of pain to fully comprehend how pain catastrophizing influences child pain experiences.[21] While child pain catastrophizing has been shown to predict pain intensity in children,[14] parental catastrophizing about child pain is associated with increased parental distress, as well as increased child distress and pain intensity in experimental and acute pain contexts.[5, 6, 19] The impact of catastrophizing on parental caregiving behaviour likely underlies this relationship with children's outcomes; specifically, research has shown that parents who catastrophize about their child's pain engage in more protective responses, which are associated with increased child pain and distress.[6, 8]

The majority of catastrophizing research has utilised the Pain Catastrophizing Scale (PCS),[38] which has been adapted for use with children (PCS-C)[14] and parents (PCS-P).[18] The PCS captures trait pain catastrophizing, (i.e., an individual's general tendency to catastrophize about pain) and taps three dimensions of catastrophizing: *rumination* (focused attention on symptoms and possible causes/consequences of pain); *magnification* (preferential processing of threatening details of pain experiences); and *helplessness* (low perceived ability to cope with pain). This three-factor solution has been replicated for the trait PCS-C[14, 30] and PCS-P.[18] Research examining child and parent trait pain catastrophizing has

shown significant correlations among children with chronic pain and their parents, but not amongst children experiencing post-operative, acute clinical, or experimental pain.[3, 17, 28, 47]

Trait catastrophizing measures focus on responses to pain generally; however, the extent to which these responses reflect behaviour across different pain experiences is unknown. Studies in adults indicate correlations between trait (i.e., general tendency to engage in catastrophic thinking) and state catastrophizing (i.e., tendency to engage in catastrophic thinking in the present moment, which can fluctuate over time) measures are consistently moderate at best.[15, 16] Furthermore, state and trait catastrophizing seem to make differential contributions to pain-related outcomes for both clinical and healthy samples.[10] While relatively few studies have examined state pain catastrophizing for parents and children,[31] indirect evidence suggests state pain catastrophizing plays a distinct role from trait catastrophizing. Indeed, recent research found that, compared to trait pain catastrophizing, state pain catastrophizing was a stronger predictor of parent and child ratings of pain intensity and unpleasantness during the cold pressor task,[3] and was associated with higher cold pressor pain ratings in youth with new onset pain problems.[24] Accordingly, it may be more useful to measure catastrophizing in relation to *specific* painful events, particularly for acute pain experiences.[10, 31, 33, 37] However, validation of parent and child state measures is needed to draw conclusions about differential contributions of state versus trait pain catastrophizing. Although state measures are already in use in research,[3, 4, 7-9, 24, 41, 44, 46] these measures vary in item length (i.e., 3- and 6-item scales are in use); and, to date, no existing study has evaluated the psychometric robustness of these measures.

The aim of this research was to examine the psychometric properties of the 3- and 6-item state versions of the PCS-C/PCS-P using archival data pooled from studies conducted in Belgium and Canada.[3, 4, 7-9, 41, 44, 46] The following psychometric properties were assessed: [1] factor structure; [2] reliability (internal consistency); and [3] predictive validity of the PCS-

C/PCS-P State versions relative to corresponding trait versions for child and parental pain-related outcomes.

Method

Ethical Considerations

Ethical approval for the secondary analyses was granted by the School of Psychology Research Ethics Committee at NUI Galway. The ethical review committees of the Faculty of Psychology and Educational Sciences at Ghent University and the IWK Health Centre Research Ethics Board granted ethical approval for each individual original study and provided approval to share the data for the purposes of secondary analyses. All participants gave consent/assent for original study participation.

Participants

Data were pooled from eight research studies from two international research centres (Department of Experimental-Clinical and Health Psychology at Ghent University and Centre for Pediatric Pain Research at the IWK Health Centre) involving community-based samples of children and their parents. Information regarding recruitment and eligibility criteria for these studies has been previously published.[3, 4, 7-9, 41, 44, 46] The final sample included 689 children (51.7% female) aged 8–18 years (M=11.69 years, SD=2.00) and 888 parents (65.7% mothers). Of the total sample, 75.5% of participants completed catastrophizing measures in Dutch. For the majority of the studies, child participants underwent an experimental pain induction task (i.e., cold pressor task [CPT], heat pain stimulation, pressure pain). In one study, children did not undergo a painful procedure; parents were instead presented with vignettes outlining possible acute pain experiences a child could be subjected to, and instructed to imagine these acute pain situations happening to their child.[7] (See Table 1 for pain tasks across included studies).

Insert Table 1 around here.

Measures

Child measures.

Trait pain catastrophizing. The Pain Catastrophizing Scale for Children (PCS-C)[14] consists of 13 items describing thoughts or feelings the child may have when in pain. The three PCS-C subscales assess rumination, magnification, and helplessness (defined earlier). All items were rated on a 5-point Likert scale from 0 ("not at all") to 4 ("extremely") and summed, such that higher scores indicated higher levels of pain catastrophizing. The PCS-C has been shown to have good internal consistency (α=.84–.89).[14]

State pain catastrophizing. Two versions of the PCS-C State were used; some studies used a 6-item form of the state scales,[3, 4, 8, 46] while others used 3-item scales.[41, 44] The 6-item form includes identical items to the 3-item form, plus 3 additional items. The state version of the PCS-C was composed of one or two adapted item(s) from each subscale of the trait version in Dutch. Items that had the highest factor loadings to their respective subscale, and which were easily adapted to reflect thoughts about a specific pain situation were selected to form the state versions.[14, 42, 43] A combination of back translation and reference to the formulation of English trait items was used to produce the state items in English. Children were asked to rate the 3 (*n*=91) or 6 items (*n*=399) on an 11-point NRS from 0 ("not at all") to 10 ("a lot") before undergoing the painful task. Total scores were calculated as a sum of individual items, such that higher scores indicated higher levels of pain catastrophizing. See Appendix A for English language items.

Pain intensity. Depending on original studies, children were asked to report how much pain they had experienced using the Faces Pain Scale Revised[23] or an 11-point NRS from 0 ("no pain") to 10 ("a lot of pain") after the painful task. These measures of pain intensity have been demonstrated to be highly correlated.[12]

State anxiety. Child state anxiety was measured using a single item: "*How anxious were you during the painful task?*" on an 11-point NRS.[6, 8, 9, 41, 44, 46] In one study, children rated their anxiety after a CPT on a 10cm visual analogue scale.[4] For both measures, children rated their anxiety from 0 ("not at all anxious") to 10 ("extremely anxious") immediately following the painful task. One study did not include a measure of state anxiety.[3]

Parent measures.

Trait pain catastrophizing. The Pain Catastrophizing Scale for Parents (PCS-P)[18] consists of 13 items describing thoughts and feelings parents may experience when their child is in pain. Three PCS-P subscales assess rumination, magnification, and helplessness. Items were rated on a 5-point Likert scale from 0 ("not at all") to 4 ("extremely") and summed, such that higher scores indicated higher levels of pain catastrophizing. The PCS-P has been shown to have good internal consistency (α=.81–.93).[18]

State pain catastrophizing. Two versions of the PCS-P State were used; some studies used a 6-item form of the state scales,[3, 4, 8, 9, 41, 46] while others used 3-item scales.[7, 44] The 6-item form includes identical items to the 3-item form, plus 3 additional items. Like the PCS-C State, PCS-P State consisted of items adapted from each subscale of the respective trait measure in Dutch. Items that had the highest factor loadings to their respective subscale, and which were easily adapted to reflect thoughts about a specific pain situation were selected to form the state versions.[18, 19] A combination of back translation and formulation of the English trait items was used to produce the English language version. Parents rated 3 (*n*=451) or 6

items (*n*=437) on an 11-point NRS from 0 (“not at all”) to 10 (“a lot”) before the child underwent the painful task. Total scores were calculated as a sum of individual items, such that higher scores indicated higher levels of pain catastrophizing. See Appendix A for English language items.

Parental distress. Parents were asked to rate to what extent they experienced various emotions after their child underwent the painful task. Emotional adjectives were rated on an 11-point NRS from 0 (“not at all”) to 10 (“extremely”). The list included four adjectives reflecting self-oriented distress (i.e., worried, upset, anxious and sad). Mean parental distress scores ranging from 0 to 10 were calculated, with higher scores indicating higher levels of distress. Use of emotional adjectives to measure parental emotions has been conceptually and empirically shown to be a reliable and valid measure.[1, 20]

Procedures

In all studies, parents and children completed the PCS-P/PCS-C Trait respectively at baseline and the PCS-P/PCS-C State prior to the painful procedure or task. In addition, children self-reported pain intensity and anxiety immediately after the painful procedure or task, while parents rated their distress after having observed their child in pain.

Data Analysis

Exploratory factor analysis (EFA) was conducted to explore the latent factor structure of the 6-item forms of the PCS-C/PCS-P State. EFAs were conducted using principal axis factoring.[13, 27] In selecting a factor structure, criteria included eigenvalues ≥ 1.0[13] and approximately 50% of variance explained.[40] Given that correlation of underlying factors was expected, oblique (promax) rotation was deemed to be most appropriate.[13, 27] Items with a primary factor loading of >.40 were retained.[40] Internal consistency was examined with the

Cronbach's alpha coefficient. This approach to EFA is similar to that used in previous paediatric pain research.[27] EFA was also conducted on the equivalent PCS-C/PCS-P Trait items to provide additional support for the factor structure of the state versions.

Next, hierarchical linear regression analyses were conducted to explore the relative contribution of state versus trait pain catastrophizing to variance in child (i.e., pain intensity and anxiety) and parent (i.e., distress) outcomes. Specifically, for each outcome variable, two hierarchical linear regressions were conducted to investigate: [1] the relative impact of child catastrophic thoughts; and [2] the relative impact of parental catastrophic thoughts. State and trait forms of the PCS-C/PCS-P were completed in either English or Dutch, depending on where the study was conducted (Canada or Belgium). Consequently, language was controlled for in all analyses. In addition, child sex and age were controlled for in all analyses, as was parent sex in the analyses of parent data, as differences have been reported between pain catastrophizing for boys and girls,[14, 25] and mothers and fathers.[22] Control variables were entered in the first step. In the second step, total scores for PCS-C/PCS-P Trait and State versions were entered.

Results

Exploratory Factor Analysis (EFA)

EFA was conducted on the 6-item forms of the PCS-C/PCS-P State to examine the underlying factor structure of the scales. Factor loadings for all measures are displayed in Table 2.

For the PCS-C State, EFA with principal axis factoring for 399 participants[3, 4, 8, 9, 46] resulted in one factor with an initial eigenvalue estimate of 3.33 and 55.53% of variance explained. All items acceptably loaded on this single factor (≥.45). For the PCS-P State, EFA with principal axis factoring for 437 participants[3, 4, 6, 8, 9] resulted in one factor with an initial

eigenvalue estimate of 2.98 and 49.72% of variance explained. All items acceptably loaded on this single factor (≥.50).

EFA was subsequently conducted on the PCS-C/PCS-P trait measures using the equivalent 6 items from the state measures. For the PCS-C Trait, EFA with principal axis factoring for 675 participants[3, 4, 7-9, 41, 44, 46] resulted in one factor with an initial eigenvalue estimate of 2.76 and 45.91% of variance explained. All items loaded acceptably on this single factor (≥.46). For the PCS-P Trait, EFA with principal axis factoring for 877 participants[3, 4, 7-9, 41, 44, 46] resulted in one factor with an initial eigenvalue estimate of 3.36 and 56.05% of variance explained. All items loaded acceptably on this single factor (≥.51).

Insert Table 2 around here.

Internal consistency of the model.

Internal consistency was assessed using Cronbach's alpha (α). Internal consistency for the PCS-C State was high; α=.84 and α=.79 for the 6- and 3-item forms respectively. Internal consistency was slightly lower, albeit still in the acceptable range,[29] for the PCS-P State; α=.79 and α=.73 for 6- and 3-item forms respectively.

6- versus 3-item forms.

High correlations between total scores for both the 6- and 3-item parent (*r*=.90) and child (*r*=.94) measures suggested that the 6- and 3-item scales provide essentially the same information. Because of this, as well as [1] the greater clinical utility of the shorter scales, and [2] a larger sample pool available for the 3-item scale, the 3-item scale was used in all

subsequent analyses. The 3-item total scores for the entire sample were obtained by using the scores of participants who completed the 3-item measures, plus using the 3 relevant items from the children and parents who completed the 6-item measures.

Descriptive Statistics

See Table 3 for the means, standard deviations and ranges of all included measures. Skewness (<.8) and kurtosis (<1) values were acceptable for all variables.

Insert Table 3 around here.

English versus Dutch-Speaking Samples

Given that the language of catastrophizing measures differed, independent samples *t*-tests were conducted to compare pain catastrophizing scores between Dutch-speaking versus English-speaking participants in order to inform control procedures in subsequent analyses. English-speaking participants scored higher than Dutch-speaking participants on both the PCS-C Trait ($t_{(303.75)}$=8.52, p<.001) and PCS-P Trait ($t_{(879)}$=4.94, p<.001). Opposite results were found for state measures; Dutch-speaking participants scored higher than English-speaking participants on both the PCS-C State ($t_{(478.18)}$=-4.01, p<.001) and PCS-P State ($t_{(487)}$=-2.65, p<.01). Means and standard deviations are displayed in Table 4.

Insert Table 4 around here.

Correlations

Correlation analyses indicated that although state and trait catastrophizing were significantly positively correlated within both child (r=.22, p<.001) and parent (r=.35, p<.001) samples, these correlations were weak to moderate. State (r=.13, p<.01) and trait (r=.10, p<.01) pain catastrophizing scores were also significantly but weakly positively correlated between parents and children. State pain catastrophizing scores were more strongly associated with pain intensity and state anxiety for children, and distress for parents, than their respective trait pain catastrophizing scores. Correlations are displayed in Table 5.

Insert Table 5 around here.

Regression Analyses

Six hierarchical linear regressions were conducted to investigate the contribution of parent and child state and trait catastrophizing in explaining [1] child pain intensity, [2] child state anxiety, and [3] parental distress as dependent variables. In each analysis, language spoken (0=English, 1=Dutch), child sex (0=boys, 1=girls), and child age were controlled for in step 1, as well as parent sex (0=mothers, 1=fathers) in the analyses that involved parental catastrophizing as an independent variable. State and trait catastrophizing were entered in step 2 for both child and parent analyses.

No strong relationships were observed between independent variables (r≤.6). Variance inflation factor values (<5; 1.01–3.31) and tolerance values (>.1) for all independent variables were adequate, thereby demonstrating that there was no issue with multicollinearity in the data. Consequently, all assumptions of multiple regression were met.

Results of the regression analyses are presented in Tables 6 and 7. Where the relative contribution of state versus trait catastrophizing was unclear (i.e., both contributed significantly to the model), the difference in their unstandardized beta coefficients was calculated by statistically comparing the beta weights, thereby allowing conclusions regarding whether the observed associations with the dependent variable are significantly different.[10]

Child pain intensity.

In the analysis of the contribution of child pain catastrophizing on children's pain intensity, PCS-C State scores had a significant contribution to the model (β=.33, p<.001), such that higher scores were associated with greater pain intensity. This was beyond the effect of covariates, of which only language was significant. PCS-C Trait scores did not make a significant contribution to the model. The entire model explained 24% of the total variance in child pain intensity.

In the analysis of the contribution of parental pain catastrophizing on children's pain intensity, PCS-P State scores also contributed significantly to the model (β=.11, p<.05), beyond the significant effect of language. PCS-P Trait scores made no unique significant contribution to the model, which explained 11% of the variance in child pain intensity overall.

Child state anxiety.

In the analysis of the contribution of child pain catastrophizing on children's state anxiety, both PCS-C Trait and State scores contributed significantly to variance in child state anxiety, such that higher scores predicted increased anxiety following the painful experience. Beta weight comparisons revealed that, relative to trait scores (β=.11, p<.05), state scores (β=.48, p<.001) made a significantly stronger unique contribution to the model (Z=5.89,

$p<.001$). This was beyond the effect of covariates, of which only language was uniquely significant. The overall model predicted 31% of the variance in child anxiety.

In the analysis of the contribution of parental pain catastrophizing on children's state anxiety, neither PCS-P Trait nor State scores made a significant contribution to variance in child state anxiety. Of the covariates, language and child age were uniquely significant, such that completing measures in Dutch and younger child age were associated with increased child anxiety. The overall model predicted 4% of the variance in child state anxiety.

Parental distress.

In the analysis of the contribution of child pain catastrophizing on parental distress, PCS-C State scores were predictive of parental distress ($\beta=.12$, $p<.05$), such that higher scores were associated with higher levels of distress; beyond the effect of covariates, of which only language was uniquely significant. PCS-C Trait scores made no significant contribution to the model, which explained 8% of the variance in parental distress.

In the analysis of the contribution of parental pain catastrophizing on parental distress, both PCS-P Trait ($\beta=.11$, $p<.05$) and State scores ($\beta=.34$, $p<.001$) made a significant contribution to the model, such that higher scores were associated with higher levels of distress. Beta weight comparison revealed that PCS-P State scores contributed significantly more to variation in parental distress scores than PCS-P Trait scores ($Z=5.92$, $p<.001$). This was beyond the effect of covariates, of which only language was uniquely significant. The overall model accounted for 22% of the variance in parental distress.

Insert Table 6 around here.

Insert Table 7 around here.

Discussion

This research is the first to assess the psychometric properties of state measures of child and parental catastrophizing about child acute pain, and examine the relative contribution of state and trait catastrophizing in explaining child and parent outcomes in a large community-based sample. The state measures included items from the trait assessment of pain catastrophizing (PCS-C/PCS-P) specifically adapted to refer to specific painful events. In contrast to the 3-factor structure obtained for trait assessment of pain catastrophizing (rumination, magnification, helplessness), results indicated that a single factor best captured the structure of state pain catastrophizing for both children and parents. Good internal consistency of the PCS-C/PCS-P State was demonstrated for parent and child groups, and was comparable to that of the trait scales. Preliminary validation of the state measures was supported by significant relationships with child and parent pain-related outcomes (i.e. child pain intensity, child state anxiety and parental distress), which were stronger than relationships for trait measures.

These findings extend the literature by suggesting that state pain catastrophizing may be best conceptualised as a global construct, as opposed to trait pain catastrophizing, which consists of three distinct dimensions.[14, 18, 30, 38] Although future research may be necessary to validate a full 13-item state pain catastrophizing scale for children and parents, the current findings validate past usages of existing state assessment total or mean scores (e.g.,[6, 8, 45]) and has important implications for future research. PCS-C/PCS-P State items were selected to represent the rumination, magnification, and helplessness subscales of the respective trait

measures, suggesting that each item score could be utilised individually to assess the three dimensions of catastrophizing. The current findings reveal that PCS-C/PCS-P State may be best explained by a one-factor model; therefore, we recommend that future research could continue to utilise a total score to represent the construct of state pain catastrophizing.

In particular, previous studies have been incongruent with respect to the number of items used within the state assessment of pain catastrophizing. Results from this study suggest that a 3-item version of the PCS-C/PCS-P State may be the optimal, most parsimonious means of assessing child and parental state pain catastrophizing. Correlational analyses revealed that the 6- and 3-item PCS-C/PCS-P State total scores were highly correlated, suggesting that the 6-item version offers little additional information. Consequently, the 3-item scales offer a concise tool for assessing state pain catastrophizing in parents and children that can be efficiently used in busy clinical and research settings. This may increase the likelihood of their inclusion in clinical intervention trials as well as a variety of clinical settings, which may be particularly important for children with chronic pain. Specifically, previous findings have indicated that state pain catastrophizing plays a stronger role than trait pain catastrophizing in the daily fluctuations of chronic pain for adults, and greater trait pain catastrophizing seems to significantly increase the effect of state pain catastrophizing on pain intensity.[37] However, further investigation using samples of children with chronic pain is needed.

In accordance with expectations, state and trait pain catastrophizing were significantly positively correlated within both child and parent samples, but only moderately so (r=.23–.42). This supports previous findings that a general tendency to catastrophize about pain is only weakly correlated with catastrophizing in a specific painful situation in these samples without chronic pain.[10] It may be that different aspects of pain catastrophizing are important in trait versus state catastrophizing. Examination of factor loadings suggests that rumination

may be distinctly important for state pain catastrophizing assessment in experimental pain contexts; state items drawn from the rumination subscale of the trait measures had notably higher factor loadings, particularly for parents (see Table 2). Further research is necessary to determine whether helplessness and magnification play a stronger role for children in a clinical pain context, as children and parents may have less perceived control and may be more likely to magnify the threat value of pain when undergoing a painful medical procedure. Furthermore, recent evidence suggests that incongruence between levels of trait parental and child catastrophizing may result in poor pain-related outcomes.[26, 34] This may be particularly relevant for state pain catastrophizing as incongruent levels may reflect conflicting pain management strategies or poor communication within the context of the pain event, and offer important intervention opportunities at the individual and dyadic levels.[34]

Additionally, this research supports extant perspectives that there is a meaningful distinction between state and trait pain catastrophizing. Exploration of the relative contribution of state versus trait pain catastrophizing revealed differential contributions to child and parent outcomes following experimental child pain. Specifically, child and parent state pain catastrophizing made a stronger unique contribution as compared to trait pain catastrophizing for child pain intensity and parent distress in response to child acute experimental pain. With regards to child state anxiety, both child state and trait pain catastrophizing had a significant influence; however, state pain catastrophizing was a stronger predictor of this outcome. Similar results were found for parental distress, whereby parent state pain catastrophizing was demonstrated to predict significantly more variance in distress scores than trait pain catastrophizing. Overall, state pain catastrophizing was a stronger predictor of pain-related outcomes than trait pain catastrophizing; and often, trait pain catastrophizing did not significantly predict outcomes. These findings support previous research demonstrating stronger relative influence of state versus trait pain catastrophizing on

adult experimental pain responses.[3, 10, 36] Similarly, results from this study indicate that state pain catastrophizing contributed significantly to models explaining child pain intensity – further emphasising the importance of assessing situation-specific catastrophizing to fully understand children's acute pain experiences. Further research is needed to explore the nature of the relationship between state and trait measures of catastrophizing, specifically examining why state measures demonstrate greater predictive value than their trait counterparts in the context of an acute pain experience. Given that trait measures are typically administered at a point in time more distal from the pain stimulus, is it possible that proximity in time may contribute to the higher predictive value of state measures. Alternatively, it may be that the specificity of the pain target explains the state measures' predictive strength. Experimentally manipulating the timing of administration may elucidate this matter; however, these might have differential levels of relevance for different individuals based on individual characteristics and pain history (e.g., what they reflect on when asked about trait pain catastrophizing).

The current study is not without limitations. First, the small number of items on previous state scales precluded deriving a 3-factor measure. Furthermore, although a stable 2-factor solution could have been revealed for the 6-item measures,[32] a factor with fewer than three items is generally unstable,[13] and thus, it is unsurprising that a one factor solution was found. However, conducting EFA was deemed worthwhile in this instance, as EFA can identify how much variance the single factor solution can explain and parameters yielded provide further evidence of the validity and utility of the measures. Indeed, the variance accounted for and strong relationships with child and parent outcomes provide good evidence that the state measures are robust and useful for inclusion in research on paediatric acute pain. Furthermore, these analyses were warranted given that these state measures are already widely in use within paediatric pain research.[3, 4, 6-9, 24, 41, 44, 46] Second, the response scales for

state and trait measures were different (0–4 versus 0–10), which may have influenced the information provided for each item. Furthermore, child pain intensity and state anxiety were measured using single items, which, though extensively validated,[48] might be limited relative to multiple-item scales. Additionally, not all outcome measures were collected across studies, resulting in exclusion of some participants for some analyses. However, the cumulative dataset used in this study is sufficiently large and representative in terms of age and sex to allow for fairly robust, generalisable conclusions to be drawn. This study also demonstrates an important first step towards understanding the dynamics of state and trait pain catastrophizing in acute paediatric pain; although more research utilising clinical groups with a wide range of conditions is needed, particularly chronic pain. Finally, further research is also needed to examine the impact of language and cultural differences on state pain catastrophizing. Language emerged as an important contributor to child and parental outcomes in several regression analyses. Although participants completed the scales in either English or Dutch, the majority were Dutch-speaking, and pain catastrophizing scores differed significantly between Dutch-speaking and English-speaking samples. The English-speaking sample was not sufficiently large to conduct analyses for each language separately, thereby preventing more in-depth investigations of the differences. It is unclear whether significant effects of language are an artefact of the translation of the scales, for example, an issue of semantic equivalence (i.e., similarity of meaning in each culture after translation), a result of cultural differences, or other important differences between studies (e.g., sample characteristics or painful tasks).[2, 35] For instance, although age and sex were roughly evenly distributed within all pain tasks, the entire English-speaking sample completed the CPT, which could be less threatening than the other pain tasks included in these analyses, thus potentially resulting in lower state catastrophizing scores for the English-speaking sample. Additionally, the English-speaking sample was 2 years younger than the Dutch-speaking

sample on average, which could have impacted results. Further research using a larger variety of international samples is needed to explore these possibilities.

This research is the first to empirically examine the psychometric properties of the PCS-C/PCS-P State in a large, diverse sample of children and their parents. This research offers preliminary support for the validity and reliability of a concise 3-item measure of state pain catastrophizing that can readily be used in clinical and research settings. Although additional research is needed to provide further support for this one-factor model of state pain catastrophizing (e.g., using confirmatory factor analyses and/or item response theory), this research represents an important first step towards robust and valid measurement of state pain catastrophizing. Furthermore, the current findings emphasise the importance of assessing child and parent pain catastrophizing in relation to specific and acutely painful events, by demonstrating a stronger relative contribution of state pain catastrophizing over trait catastrophizing for both child and parent pain-related outcomes.

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Appendix A: PCS-C/PCS-P State Items and PCS Subscales

Substitute italic text for alternative pain tasks or medical procedures as appropriate.

PCS-C State

1. At this moment, to what extent do you keep on thinking about the pain you will experience during *the cold water task*?* (Rumination)
2. At this moment, to what extent do you think something serious might happen to you because of the pain?* (Magnification)
3. At this moment, to what extent do you think you won' be able to stand *the cold water task* because of the pain?* (Helplessness)
4. At this moment, to what extent do you keep thinking of other painful experiences? (Magnification)
5. At this moment, to what extent do you think there is nothing you can do to reduce the pain during *the cold water task*? (Helplessness)
6. At this moment, how hard is it to keep the pain you will experience during *the cold water task* out of your mind? (Rumination)

PCS-P State

1. At this moment, to what extent do you keep on thinking about the pain your child will experience during *the cold water task*?* (Rumination)
2. At this moment, to what extent do you think something serious might happen to your child because of the pain?* (Magnification)
3. At this moment, to what extent do you think that, because of the pain of your child, you will not be able to stand *the cold water task*?* (Helplessness)

4. At this moment, to what extent do you keep thinking of other painful experiences? (Magnification)
5. At this moment, to what extent do you think there will be nothing you can do to reduce the pain of your child during *the cold water task*? (Helplessness)
6. At this moment, how hard is it to keep the pain that your child will experience during *the cold water task* out of your mind? (Rumination)

* Items included in the 3-item version of the scales

Table Legend

Table 1.

Pain Tasks across Included Studies

Pain induction	***n* (% of total)**	**Mean age (SD)**	**% female**	**% Dutch-speaking**
Cold pressor task (CPT)	381 (55.3)	11.42 (2.26)	50.4	42.8
Pressure-pain procedure	53 (7.7)	11.74 (1.73)	54.7	100.0
Heat pain procedure	56 (8.1)	13.07 (1.33)	50.0	100.0
Vignettes	199 (28.9)	11.74 (1.75)	52.8	100.0

Table 2.

Factor Loadings Specified in the One-Factor Models

PCS-C State item	**6-item**	**PCS-P State item**	**6-item**
1. At this moment, to what extent do you keep on thinking about the pain you will experience during *the cold water task*? (R)	.76	1. At this moment, to what extent do you keep on thinking about the pain your child will experience during *the cold water task*? (R)	.75
2. At this moment, to what extent do you think something serious might happen to you because of the pain? (M)	.71	2. At this moment, to what extent do you think something serious might happen to your child because of the pain? (M)	.57
3. At this moment, to what extent do you think you won't be able to stand *the cold water task* because of the pain? (H)	.78	3. At this moment, to what extent do you think that, because of the pain of your child, you will not be able to stand *the cold water task*? (H)	.63
4. At this moment, to what extent do you keep thinking of other painful experiences? (M)	.45	4. At this moment, to what extent do you keep thinking of other painful experiences? (M)	.50
5. At this moment, to what extent do you think there is nothing you can do to reduce the pain during *the cold water task*? (H)	.60	5. At this moment, to what extent do you think there will be nothing you can do to reduce the pain of your child during *the cold water task*? (H)	.58
6. At this moment, how hard is it to keep the pain you will experience during *the cold water task* out of your mind? (R)	.78	6. At this moment, how hard is it to keep the pain that your child will experience during *the cold water task* out of your mind? (R)	.73

R = rumination, M = magnification, H = helplessness

Note: *'the cold water task'* was replaced with the name of the task relevant to each individual study.

Table 3.

Descriptive Statistics

Measure	***n***	***M***	***SD***	**Range**	**Possible range**
PCS-C Trait	667	16.02	9.07	0 – 48	0 – 52
PCS-P Trait	881	15.76	9.35	0 – 52	0 – 52
PCS-C State (3-items)	488	6.94	6.01	0 – 28	0 – 30
PCS-P State (3-items)	489	4.97	4.47	0 – 22	0 – 30
Child pain intensity	374	5.09	2.97	0 – 10	0 – 10
Child state anxiety	318	3.40	2.59	0 – 10	0 – 10
Parent distress	882	2.43	2.38	0 – 10	0 – 10

Table 4.

State and Trait Catastrophizing Scores for English- versus Dutch-Speaking Samples

	English-speaking		**Dutch-speaking**	
	M	***SD***	***M***	***SD***
PCS-C State* **	5.74	5.64	7.90	6.15
PCS-C Trait* **	20.37	10.61	14.55	7.98
PCS-P State **	4.37	4.33	5.45	4.53
PCS-P Trait* **	18.45	9.54	14.88	9.12

Significant differences between English- and Dutch-speaking participants within each catastrophizing measure. ** $p<.01$, *** $p<.001$

Table 5.

Pearson Correlation Coefficients Between Included Variables

		1	2	3	4	5	6	7
1	PCS-C Trait	-						
2	PCS-P Trait	.10**	-					
3	PCS-C State (3-item)	.22***	.03	-				
4	PCS-P State (3-item)	-.05	.35***	.13**	-			
5	Child pain intensity	.04	-.08	.41***	.09	-		
6	Child state anxiety	.23***	.06	.54***	.03	.61***	-	
7	Parent distress	-.05	.12***	.16***	.41***	.20***	.10	-

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

Table 6.

Hierarchical Regression Analyses of the Contribution of Child Pain Catastrophizing to Child and Parent Outcomes

Criterion Variable	Step	Predictor	β	ΔR^2	Adj. R^2	F change
Child pain intensity	1	Language	.34***			
		Child age	-.04			
		Child sex	.00			
	2	PCS-C Trait	.10			
		PCS-C State	.33***	.13	.24	31.41***
Child state anxiety	1	Language	.18**			
		Child age	-.06			
		Child sex	.05			
	2	PCS-C Trait	.11*			
		PCS-C State	.48***	.27	.31	60.79***
Parental distress	1	Language	.28***			
		Child age	-.08			
		Child sex	.01			
	2	PCS-C Trait	-.03			
		PCS-C State	.12*	.01	.08	3.21*

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

Table 7.

Hierarchical Regression Analyses of the Contribution of Parental Pain Catastrophizing to Child and Parent Outcomes

Criterion Variable	Step	Predictor	β	ΔR^2	Adj. R^2	*F* change
Child pain intensity	1	Language	.39***			
		Child age	-.11			
		Child sex	.04			
		Parent sex	-.05			
	2	PCS-P Trait	-.09			
		PCS-P State	.11*	.01	.11	2.51
Child state anxiety	1	Language	.20**			
		Child age	-.16**			
		Child sex	.10			
		Parent sex	-.08			
	2	PCS-P Trait	.10			
		PCS-P State	-.04	.01	.04	1.37
Parental distress	1	Language	.28***			
		Child age	-.07			
		Child sex	-.00			
		Parent sex	-.03			
	2	PCS-P Trait	.11*			
		PCS-P State	.34***	.15	.22	47.15***

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