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Child catastrophizing about parent chronic pain: A potential child vulnerability factor

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Objective. Robust evidence suggests children's catastrophizing about their own pain is a risk factor for poor child pain-related outcomes. In children of parents with chronic pain, child catastrophizing about their parents' pain might be a unique predictor of child pain-related outcomes given their increased exposure to parental chronic pain and disability. The objective of this study was to examine associations between child and parent catastrophizing about their own and each other's pain and child and parent pain-related outcomes.

Methods. Seventy-two parents with chronic pain and their children (ages 8–15) completed questionnaires assessing their trait catastrophizing about their own and each other's pain, their own pain, and the child's internalizing symptoms. Children completed the cold pressor task (CPT) in the presence of their parent. Parents and children rated children's worst pain intensity and their own anxiety during the task. Analyses were guided by the Actor-Partner Interdependence Model.

Results. Greater child catastrophizing about parent pain was associated with children's and parents' increased catastrophizing about their own pain. Child catastrophizing about parent pain was associated with greater child- and parent-reported child internalizing symptoms and greater CPT pain intensity for the child, but not parent/child usual pain or CPT anxiety, over and above the influence of parent and child catastrophizing about their own pain.

Conclusions. Child catastrophizing about parent pain is a potential vulnerability factor associated with poor pain-related outcomes in children of parents with chronic pain that should be considered in future research and clinical settings.

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Statement of contribution

What is already known on this subject?

- Higher rates of pain and internalizing symptoms are observed in offspring of parents with vs. without chronic pain.
- Greater child and parent pain catastrophizing are associated with poorer pain-related outcomes in children.
- Child catastrophizing about parent chronic pain and its association with child outcomes has not been examined.

What does this study add?

- Greater child catastrophizing about parent chronic pain is associated with greater child internalizing and CPT pain.
- These effects were seen beyond the association of child and parent catastrophizing about their own pain.

Chronic pain is a common health problem in children and adults (Johannes, Le, Zhou, Johnston, & Dworkin, 2010; King *et al.*, 2011) that tends to aggregate in families (Hoftun, Romundstad, & Rygg, 2013). A large population-based study found that the prevalence of chronic pain was 43.2% in offspring with one parent with chronic pain and 50.9% when both parents had chronic pain (Hoftun *et al.*, 2013). Children of parents with chronic pain have been identified as a population particularly vulnerable to problems with pain and mental health (e.g., internalizing symptoms; Higgins *et al.*, 2015). Improved understanding of risk and protective factors associated with child outcomes is needed to support this vulnerable population.

A recently proposed theoretical model of the intergenerational transmission of risk for chronic pain posits that several mechanisms account for the transmission of risk from parents to children (e.g., genetics, early neurobiological development, social learning), resulting in children developing characteristics that make them more vulnerable to pain and psychological disorders (e.g., altered pain processing, pain-related cognitions; Stone & Wilson, 2016). Preliminary support for social learning (Stone, Bruehl, Smith, Garber, & Walker, 2018) and neurobiological development (Cservenka, Stein, Wilson, & Nagel, 2015) mechanisms has been found. Pain-related cognitions are one class of child vulnerability characteristics through which parental chronic pain might impact children (Stone & Wilson, 2016). Pain catastrophizing, the tendency to view (presently occurring or future) pain in an exaggerated, negative way (Sullivan, 1995), is a pain-related cognition which may act as a child vulnerability factor in the context of parental chronic pain (Stone & Wilson, 2016). The current study examines a novel form of pain catastrophizing, child catastrophizing about parent pain, and its associations with pain-related outcomes in children of parents with chronic pain.

Much research has examined the intra- and interpersonal influences of catastrophizing about one's own pain. Robust evidence of the role of increased catastrophizing about one's own pain in predicting one's own poorer pain and mental health outcomes is found in adults and children with and without chronic pain (Birnie, Chambers, Chorney, Fernandez, & McGrath, 2016; Buenaver, Edwards, Smith, Gramling, & Haythornthwaite, 2008; Craner, Sperry, Koball, Morrison, & Gilliam, 2017; Fisher, Heathcote, Eccleston, Simons, & Palermo, 2017). Catastrophizing about one's own pain predicts own pain-related outcomes beyond the influence of similar constructs (e.g., neuroticism, negative affectivity, anxiety; Goubert, Crombez, & Van Damme, 2004; Tran *et al.*, 2015; Vervoort, Goubert, Eccleston, Bijttebier, &

Crombez, 2006). Catastrophizing about one's own pain can also have interpersonal effects. Increased parent catastrophizing about their own pain is associated with greater child pain intensity one year after major surgery (Pagé, Campbell, Isaac, Stinson, & Katz, 2013) and greater child attentional avoidance of pain-related stimuli (Vervoort, Trost, & Van Ryckeghem, 2013). Increased child catastrophizing about child pain predicts parents' reports of increased child pain intensity (Birnie *et al.*, 2016).

Intra- and interpersonal effects of catastrophizing about another person's pain have also been found. A large body of research has examined the impact of parental catastrophizing about child pain on parent and child outcomes, including in children with and without chronic pain. Regarding intrapersonal effects, increased parent catastrophizing about child pain has been associated with greater parental self-oriented distress in response to imagining their child in pain (Goubert, Vervoort, Sullivan, Verhoeven, & Crombez, 2008), depression, anxiety, and stress associated with parenting a child with a chronic illness (Goubert *et al.*, 2006). In parents with and without chronic pain, catastrophizing about child pain has been associated with increased parental protective responses to child pain (Wilson & Fales, 2015). Increased number of parent chronic pain locations has been associated with increased parent catastrophizing about child pain (Wilson *et al.*, 2014). In terms of interpersonal influences, greater parental catastrophizing about child pain has been associated with higher child pain catastrophizing, pain-related disability, and depressive symptoms (Goubert, Eccleston, Vervoort, Jordan, & Crombez, 2006; Wilson, Moss, Palermo, & Fales, 2014). Overall, higher levels of parent catastrophizing about child pain have been associated with poorer psychological outcomes in parents and pain-related outcomes in children.

While research has established the intra- and interpersonal effects of parent catastrophizing about child pain, child catastrophizing about parent pain has not previously been studied. Child catastrophizing about parent pain may confer risk to children through similar mechanisms as catastrophizing about their own pain, but may be increased in this population compared to children of parents without chronic pain given their increased exposure to parental pain and disability. This exposure may result in additional opportunities to develop negative pain-related cognitions through social learning mechanisms (Stone *et al.*, 2018; Stone & Wilson, 2016), particularly if exposed to increased parent catastrophizing about their own pain. Thus, child catastrophizing about parent pain may be a factor through which children of parents with chronic pain become vulnerable to pain and psychological difficulties (Stone & Wilson, 2016).

The aims of the current study were to assess child catastrophizing about parent pain in a sample of children of parents with chronic pain, explore associations between child and parent catastrophizing about their own and one another's pain, and examine the dyadic relationships between child and parent catastrophizing about one another's pain and parent and child pain-related outcomes. This population was chosen in order to move beyond group comparisons between children of parents with and without chronic pain to better understand potential risk factors in children of parents with chronic pain (Higgins *et al.*, 2015). Primary study hypotheses were (1) parent's and children's greater catastrophizing about their own pain would be associated with higher levels of catastrophizing about each other's pain and (2) higher levels of child catastrophizing about parent pain would be associated with greater child pain (over the previous 3 months and during a laboratory task) and internalizing symptoms, beyond the association with catastrophizing about one's own pain. The examined variables are interdependent and were tested within a dyadic model, allowing for testing of secondary hypotheses regarding associations between parent catastrophizing about child pain,

parent and child catastrophizing about their own pain, and parent and child pain-related outcomes. Secondary hypotheses were (1) higher levels of parent catastrophizing about child pain would be associated with greater child pain and greater parent anxiety during the child's laboratory pain task, and (2) higher parent and child catastrophizing about their own pain would be associated with greater parent and child pain over the previous 3 months.

Method

This study was conducted as part of a larger study of parents with chronic pain and their children examining two distinct research questions. The current paper describes the examination of child catastrophizing about parent pain as a potential vulnerability factor for child pain and psychological outcomes. The other paper describes tests of specific social learning mechanisms of the intergenerational transmission of risk for chronic pain. All study procedures were approved by the institutional Research Ethics Board.

Participants

Participants were 72 parent–child dyads in which the parent experienced chronic pain (for 6 months or more with at least moderate bodily pain over the past 4 weeks) and the child was 8 to 15 years old. Parents were recruited from an adult pain clinic (n = 50) or using community recruitment methods (n = 22; posters, social media). Parents and children were ineligible to participate if their ability to consent/assent to or participate in study tasks was affected by cognitive impairments or developmental disabilities, uncorrected hearing/vision impairments, English language difficulties, or if they did not live together at least 50% of the time. Children were also ineligible if they had contraindications for the cold pressor task (CPT; e.g., blood or circulation disorders, current injury or history of frostbite to non-dominant arm).

Measures

Child measures

Catastrophizing about own pain. Children completed the Pain Catastrophizing Scale for Children (PCS-C) (Crombez *et al.*, 2003), containing 13 items answered on a scale from 'Not at all' (0 points) to 'Extremely' (4 points). Total scores can range from 0 to 52; higher scores indicate greater catastrophizing about one's pain. Evidence suggests the measure is reliable and valid in children with and without chronic pain (Crombez *et al.*, 2003; Fisher *et al.*, 2017). Internal consistency in the current study was Cronbach's α = .92.

Catastrophizing about parent pain. Children completed a modified version of the Pain Catastrophizing Scale – Parent Version (Goubert *et al.*, 2006). The stem of all questions was modified from 'When my child is in pain. . .' to 'When my parent is in pain. . .'. The questionnaire includes 13 items answered on the same 5-point scale as the previous measure (total scores 0–52). While the original measure has been found to be reliable and valid in parents of children with and without chronic pain (Goubert *et al.*, 2006), the current study presents the first known use of this questionnaire in children. Exploratory factor analysis was used to examine the structure of the modified measure in this sample

(see Appendix S1). Results indicated that the items loaded on three highly correlated factors. In line with prior research on the PCS and related measures (Fisher *et al.*, 2017; Pagé *et al.*, 2013), total scores were used in analyses. Internal consistency in the current study was Cronbach's $\alpha = .94$.

Relationship with parent. Children were asked 'How close would you say your relationship is with your parent?', and 'How important to you is your relationship with your parent?'. Both questions were answered on an 11-point numerical rating scale (NRS) from 0 ('not close/important at all') to 10 ('very close/important'). These measures were developed for the current study to be used as potential covariates.

Pain in previous 3 months. Children completed an interview with a research assistant that was developed for a previous research study (Petter, Chambers, McGrath, & Dick, 2013) and followed guidelines for child pain assessment in research (McGrath *et al.*, 2008). The interview began by discussing events over the past 3 months to establish the timeline (e.g., holidays, school events, etc.). Children were asked about pains they had experienced during that time and identified which type of pain had occurred most often. They reported on the frequency, duration, locations, and usual intensity (0–10 NRS) of their most common pain.

Internalizing symptoms. Children completed the Behavior Assessment System for Children-2 (Reynolds & Kamphaus, 2004) Self-Report of Personality Child version (ages 8–11 years; 139 items) or Adolescent version (12–15 years; 176 items), with questions answered on true/false and 4-point response scales ('never' to 'almost always'). Evidence of its reliability and validity have been found (Reynolds & Kamphaus, 2004). Children's *T* scores ($M = 50$, $SD = 10$) on the Internalizing Problems composite scale, measuring inwardly directed distress (i.e., symptoms of anxiety and depression), were used (Reynolds & Kamphaus, 2004).

Experimental pain task outcomes. Children reported on their worst pain intensity during the CPT using the Faces Pain Scale-Revised (Hicks, von Baeyer, Spafford, van Korlaar, & Goodenough, 2001), an established, validated measure of pain intensity appropriate for children ages 4–16 years (Cohen *et al.*, 2008). It includes six faces anchored from 'No pain' (neutral face; 0 points) to 'Very much pain' (10 points). Children rated how nervous or anxious they felt 'on average, taken all together' during the CPT by marking a line on a visual analogue scale from 'Not nervous or anxious at all' (0 cm) to 'Most nervous or anxious' (10 cm).

Parent measures

Demographics. Parents completed an author-developed demographics questionnaire about themselves (age, sex, racial/ethnic identity, marital status, education level, household income, relationship to their child) and their child (age, sex, racial/ethnic identity). They

rated the closeness and importance of their relationship with their participating child using two NRS from 0 (not close/important at all) to 10 (very close/important).

Chronic pain characteristics. Parents reported on the location(s), duration, frequency, and usual pain intensity (0–10 NRS) of their most common pain in the previous 3 months using a questionnaire version of the interview that children completed (Petter *et al.*, 2013). They reported on their pain interference (the extent to which pain interfered with their mental, physical, and social activities) using the PROMIS Pain Interference Short Form 8a. This reliable and valid measure (Amtmann *et al.*, 2010; Cook *et al.*, 2016) includes eight items answered on a 5-point scale from 'Not at all' (1 point) to 'Very much' (5 points; total scores 8–40).

Catastrophizing about own pain. Parents completed the Pain Catastrophizing Scale (Sullivan, 1995; Sullivan, Bishop, & Pivik, 1995), containing 13 items on a 5-point scale from 'Not at all' (0 points) to 'All the time' (4 points; total scores 0–52). The reliability and validity of this measure in adults with and without chronic pain have been established (e.g., Osman *et al.*, 2000). Internal consistency in the current study was Cronbach's $\alpha = .92$.

Catastrophizing about child pain. Parents completed the Pain Catastrophizing Scale – Parent Version (Goubert *et al.*, 2006). This measure contains 13 items answered on a 5-point response scale from 'Not at all' to 'Extremely' (total scores ranging 0–52). It has been found to be reliable and valid in parents of children with and without chronic pain (Goubert *et al.*, 2006). Internal consistency in the current sample was Cronbach's $\alpha = .92$.

Child internalizing symptoms. Parents completed the Parent Rating Scale of the Behavior Assessment System for Children-2 (Reynolds & Kamphaus, 2004) Child version (for children 8–11 years; 160 items) or Adolescent version (12–15 years; 150 items). Items are answered on a 4-point scale from 'never' to 'almost always'. Support for its reliability and validity has been found (Reynolds & Kamphaus, 2004). Parents' *T* scores on the Internalizing Problems composite scale (assessing children's inwardly directed distress symptoms) were used.

Child experimental pain intensity. Parents reported on the child's worst pain intensity during the CPT using the Faces Pain Scale-Revised (Hicks *et al.*, 2001) so that parents and children could report on this construct with the same measure, as in previous work (Birnie *et al.*, 2016). Evidence supports its validity in adults (Ferreira-Valente, Pais-Ribeiro, & Jensen, 2011).

Anxiety during child experimental pain task. Parents reported on their own level of anxiety 'on average, taken all together' during the child's CPT using a 10-cm visual analogue scale ranging from 'Not nervous or anxious at all' (0 cm) to 'Most nervous or anxious' (10 cm).

Procedure

Children and parents attended one 90-min laboratory visit. Informed consent and assent procedures were completed with parents and children, respectively, including assessing capacity to consent/assent by asking questions about the study purpose and activities. Dyads completed the questionnaires and CPT in a counterbalanced order (questionnaires first: $n = 36$; 50.00%). Children and parents were debriefed about the study and each provided with a $20 gift card honorarium. Parents also received compensation for travel expenses ($15 or $30 based on distance travelled), and children received a Junior Scientist Certificate.

Questionnaires

Parents and children completed measures in separate rooms. The research assistant briefly reviewed written instructions for parents before they completed the measures alone, and for children read aloud instructions and recorded interview answers.

Experimental pain task

Children completed the cold pressor task (CPT), a safe and ethical laboratory pain task which induces mild-moderate pain (Birnie, Noel, Chambers, Von Baeyer, & Fernandez, 2011), following safety guidelines for this task (von Baeyer, Piira, Chambers, Trapanotto, & Zeltzer, 2005). Children placed their non-dominant hand in a bath of cold water (10 ± 0.2°C) up to the wrist and were instructed to keep their hand in as long as they could (maximum of 4 min; von Baeyer *et al.*, 2005), but were informed they could remove it whenever they wanted. Parents sat across from children during the task and dyads were encouraged to speak to each other as they would elsewhere. During the CPT, the research assistant provided instructions via intercom from another room and observed the task via closed-circuit television. Afterwards, the research assistant returned to the room and asked parents and children to rate the child's pain intensity and their own anxiety during the task independently.

Data analysis

Overall missing data were minimal (1.00%). For individuals missing $< 10\%$ of the items on a particular measure ($n = 3$ parents, $n = 3$ children), missing data were handled using Expectation Maximization imputation (Little, Jorgensen, Lang, & Whitney Moore, 2014). Bivariate correlations were conducted between potential covariates (child and parent age, sex, and ratings of relationship closeness and importance; first study task completed) and outcome variables; the only variable that met criteria for inclusion as a covariate (i.e., correlation coefficient ≥ 0.30; Frigon & Laurencelle, 1993) was parent rating of relationship closeness with the outcome variable child self-reported internalizing symptoms ($r = -.37$, $p < .01$).

Bivariate correlations examined relationships between child catastrophizing about parent pain, parent pain characteristics (chronic pain duration, usual pain intensity, pain interference), and child- and parent-reported relationship closeness and importance. To address hypotheses 1 and 2, dyadic analyses were conducted using the Actor-Partner Interdependence Model (APIM; Kenny, Kashy, & Cook, 2006) based on path analyses in R lavaan syntax (Rosseel, 2012). APIM estimates actor effects (e.g., the association between child catastrophizing about parent pain and the child's own CPT pain intensity) and

partner effects (e.g., the association between parent catastrophizing about child pain and the child's CPT pain intensity) while controlling for the other type of effect (Kenny *et al.*, 2006). Dyads were treated as distinguishable, MLR estimation was used to address any non-normality, and full information maximum likelihood addressed missing data (Little *et al.*, 2014). Based on a power analysis conducted using APIMPowerR (Ackerman & Kenny, 2016), 72 dyads exceeded the required sample size (i.e., 56 dyads) to detect average actor and partner effects of medium effect sizes (0.25) at 80% power. For the first hypothesis, an APIM analysis examined whether child and parent catastrophizing about their own pain predicted catastrophizing about one another's pain. For the second hypothesis, a series of APIM analyses examined whether child and parent catastrophizing about one another's pain predicted outcomes in everyday life (child and parent usual pain intensity of most common pain over the previous 3 months, child- and parent-reported child internalizing symptoms) and in the context of the CPT (child- and parent-reported child worst pain intensity, child and parent anxiety). Separate models were tested for each outcome variable. Child and parent catastrophizing about their own pain was included as covariates, as they are already known to impact pain-related outcomes. Unstandardized coefficients and standard errors are presented (Kenny *et al.*, 2006).

Results

Demographics of the sample are in Table 1. Most parents were mothers, married, and identified as white. All parents were the participating child's biological parent. Children were approximately evenly split between girls and boys and were most often identified by parents as white. Parent and child pain characteristics are in Table 2. Parents had chronic pain for, on average, over 10 years and reported moderate pain intensity (Boonstra *et al.*, 2016). One third of the children had chronic pain (pain other than muscle soreness due to physical activity at least once per week for at least 3 months). Descriptive statistics for study measures are in Table 3.

Correlational analyses

Child catastrophizing about parent pain was significantly correlated with parent pain interference ($r = .46$, $p < .001$), but not parents' chronic pain duration ($r = -.08$, $p > .05$) or usual pain intensity ($r = .07, p > .05$). Child catastrophizing about parent pain was not significantly associated with parent ($r = -.12, p > .05$) or child ($r = .17, p > .05$) ratings of closeness or parent ratings of relationship importance ($r = .02, p > .05$). Child catastrophizing about parent pain was positively correlated with child ratings of relationship importance ($r = .32, p < .01$).

Correlations among study variables are in Table 3. Child catastrophizing about parent pain was significantly positively correlated with children's usual pain intensity, their worst CPT pain intensity and anxiety, parent ratings of child worst CPT pain intensity, child- and parent-reported child internalizing symptoms, and child and parent catastrophizing about their own pain.

Hypothesis 1: Catastrophizing (own pain) predicting catastrophizing (other's pain)

It was hypothesized that parents' and children's greater catastrophizing about their own pain would be associated with catastrophizing about the other's pain. Significant actor

Table 1. Demographics

	Parent		Child	
	Mean (*SD*) or *n* (%)	Range	Mean (*SD*) or *n* (%)	Range
Age	42.91 years (6.49)	28.25–57.25	12.12 years (2.45)	8.01–15.96
Sex	Women: *n* = 57 (79.17%) Men: *n* = 15 (20.83%)		Girls: *n* = 39 (54.17%) Boys: *n* = 33 (45.83%)	
Race/ethnicity	White: *n* = 64 (88.89%) Bi- or multi-racial: *n* = 4 (5.55%) Other: *n* = 4 (5.55%)		White: *n* = 57 (79.17%) Bi-/multi-racial: *n* = 9 (12.50%) Other: *n* = 6 (8.33%)	
Highest education completed	High school or partial high school: *n* = 12 (16.67%) Trade school or community college: *n* = 27 (37.50%) Some university education: *n* = 16 (22.22%) Undergraduate degree: *n* = 10 (13.89%) Graduate school/professional training: *n* = 7 (9.72%)			
Marital status	Married: *n* = 47 (65.28%) Common-law relationship: *n* = 10 (13.89%) Other committed relationship: *n* = 6 (8.33%) Not in committed relationship: *n* = 9 (12.50%)			
Total annual household income	Less than $10,000: *n* = 3 (4.17%) $10,000–$25,000: *n* = 7 (9.72%) $25,000–$50,000: *n* = 16 (22.22%) $50,000–$75,000: *n* = 17 (23.61%) $75,000–$100,000: *n* = 9 (12.50%) $100,000–$125,000: *n* = 4 (5.56%) $125,000–$150,000: *n* = 3 (4.17%) More than $150,000: *n* = 7 (11.11%) Prefer not to answer: *n* = 6 (8.33%)			
Percentage of time child lived with participating parent	100% of the time: *n* = 62 (86.11%) 90% of the time: *n* = 4 (5.56%) 50–70% of the time: *n* = 4 (5.56%) Not reported: *n* = 2 (2.78%)			
Rating of relationship closeness	9.24 (1.20)	4.00–10.00	8.80 (2.04)	0.00–10.00
Rating of relationship importance	9.96 (0.20)	9.00–10.00	9.39 (1.80)	0.00–10.00

Table 2. Parent and child pain characteristics

	Mean (*SD*) or *n* (%)	Range
Parents		
Duration of having chronic pain	10.92 years (9.46)	0.42–37.60
Time since parent began receiving treatment for their chronic pain	7.94 years (7.89)	0.12–32.48
Usual pain intensity of most common pain over the past 3 months (0–10)	6.94 (1.91)	3.00–10.00
Frequency of most common pain over the past 3 months	More than once per week: *n* = 68 (94.44%) About once per week: *n* = 2 (2.78%) Once or twice per month or less: *n* = 2 (2.78%)	
Pain interference	29.26 (8.15)	10.00–40.00
Children		
Usual pain intensity of most common pain over the past 3 months (0–10)	4.93 (2.08) *Three children reported not having had any pain over the past 3 months	1.00–10.00
Frequency of most common pain over the past 3 months	More than once per week: *n* = 26 (36.11%) About once per week: *n* = 12 (16.67%) Once or twice per month or less: *n* = 31 (43.06%) No pain reported in last 3 months: *n* = 3 (4.17%)	
Duration of most common pain experienced over the past 3 months	Just this month: *n* = 8 (11.11%) Less than 3 months: *n* = 12 (16.67%) Over 3 months: *n* = 20 (27.78%) Over a year: *n* = 28 (38.89%) Missing: *n* = 1 (1.4%) No pain reported in past 3 months: *n* = 3 (4.17%)	
Presence of child chronic pain (i.e., pain other than muscle soreness following physical activity, occurring at least weekly over the previous 3 months)	Yes: *n* = 24 (33.33%) No: *n* = 48 (66.67%)	

effects were found; greater catastrophizing about one's own pain was associated with greater catastrophizing about the other's pain for both parents and children (Figure 1). There was one significant partner effect; parents' higher catastrophizing about own pain was associated with higher child catastrophizing about parent pain.

Hypothesis 2: Catastrophizing (other's pain) predicting study outcomes

It was hypothesized that higher child catastrophizing about parent pain would be associated with greater child pain intensity and internalizing symptoms, beyond associations with parent and child catastrophizing about their own pain. Secondary hypotheses were that a) higher parent catastrophizing about child pain would be associated with greater child pain and internalizing symptoms and greater parent CPT anxiety and b) that parents' and children's greater catastrophizing about their own pain would be associated with their own higher 3-month pain intensity.

Results of the APIM analyses examining these hypotheses are in Figure 2a–c. There were no significant actor ($b_{\text{child}} = -.01$, $SE = 0.02$, $p > .05$; $b_{\text{parent}} = -.03$, $SE = .03$, $p > .05$) or partner effects on children ($b = .02$, $SE = .02$, $p > .05$) or parents' ($b = .00$,

Table 3. Descriptive statistics and correlations for study measures

	Mean (*SD*)	Range	1	2	3	4	5	6	7	8	9	10	11	12
1. Child catastrophizing (parent pain)	28.48 (12.83)	0–52	–	.58***	.19	.24*	.34**	.07	.51***	.51***	.31**	.27*	.27*	.17
2. Child catastrophizing (own pain)	18.25 (11.46)	0–51		–	.07	.11	.56***	.08	.46***	.46***	.26*	.13	.42***	.11
3. Parent catastrophizing (child pain)	20.65 (10.27)	4–47			–	.56***	.13	.00	.08	.18	−.16	.21	.10	.51***
4. Parent catastrophizing (own pain)	21.00 (11.81)	0–47				–	.13	.22	.05	.24*	.06	.14	.07	.30*
5. Child usual pain intensity	4.93 (2.08)	1.00–10.00					–	.24*	.44***	.41**	.16	.07	.21	.07
6. Parent usual pain intensity	6.94 (1.91)	3.00–10.00						–	.04	.00	.23*	.21	.11	.02
7. Child self-reported Internalizing Problems T score	51.06 (10.99)	36–79							–	.58***	.20	−.01	.27*	.07
8. Parent-reported child Internalizing Problems T score	57.74 (14.40)	36–104								–	.14	.10	.41**	.11
9. Child self-reported worst CPT pain intensity	4.89 (2.55)	0–10									–	.24*	.33**	−.06
10. Parent-reported child worst CPT pain intensity	4.81 (2.48)	0–10										–	.21	.21
11. Child CPT anxiety	2.78 (2.72)	0.0–10.0 cm											–	.06
12. Parent CPT anxiety	2.74 (2.72)	0.0–9.8 cm												–

CPT = cold pressor task.
*$p < .05$; **$p < .01$; ***$p < .001$.

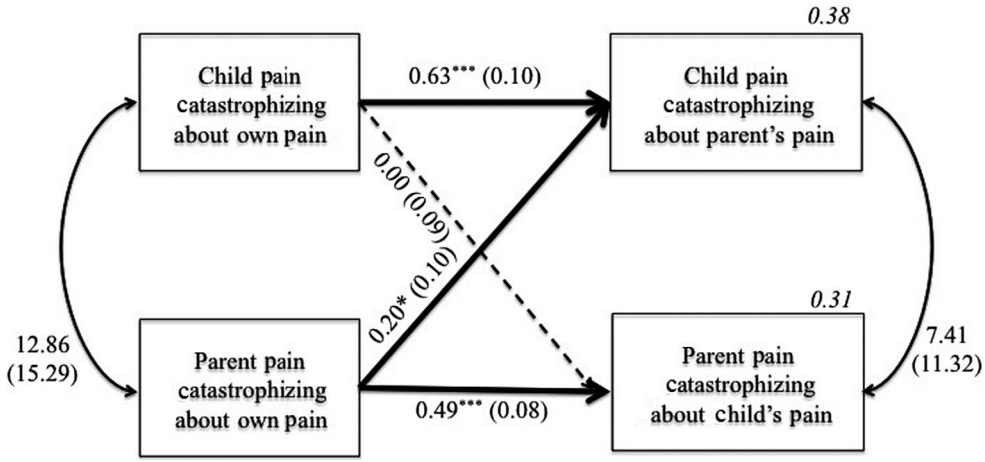

Figure 1. APIM Analysis of Child and Parent Catastrophizing About Their Own and The Other's Pain. Unstandardized coefficients and standard errors are presented. Bold lines indicate significant effects; dotted lines indicate non-significant effects. *$p < .05$, **$p < .01$, ***$p < .001$

$SE = .02$, $p > .05$) own usual pain intensity of the most common pain over the previous 3 months. However, both individuals' greater catastrophizing about their own pain was significantly associated with their own higher usual pain intensity ($b_{child} = .11$, $SE = .02$, $p < .001$; $b_{parent} = .05$, $SE = 0.02$, $p < 0.05$). In examining self- and parent-reported child internalizing symptoms, there was a significant positive actor effect of child catastrophizing about parent pain on child internalizing symptoms (Figure 2a). There was also a significant positive partner effect of child catastrophizing about parent pain on parent-reported child internalizing symptoms. Greater child catastrophizing about own pain was associated with higher self-reported ($b = .23$, $SE = .11$, $p < .05$) and parent-reported child internalizing symptoms ($b = .34$, $SE = .15$, $p < .05$). The covariate of higher parent relationship closeness was associated with lower child self-reported internalizing symptoms ($b = -2.92$, $SE = .90$, $p = .001$).

There were significant actor and partner effects of children's catastrophizing about their parents' pain during the CPT, with higher levels being associated with higher child- and parent-reported child worst pain intensity (Figure 2b). There was a significant negative partner effect of parental catastrophizing about child pain, with higher levels being associated with lower child self-reported worst pain intensity. For CPT anxiety, there was a significant actor effect for parents, with greater catastrophizing about child pain being associated with greater parent CPT anxiety (Figure 2c). Higher child catastrophizing about own pain was associated with higher child CPT anxiety ($b = .09$, $SE = .04$, $p < .05$).

Discussion

Overall, our study suggests child catastrophizing about parent pain plays a unique role in understanding child pain-related outcomes. Consistent with primary study hypotheses, higher levels of child and parent catastrophizing about their own pain were associated with greater child catastrophizing about parent pain, and greater child catastrophizing about parent pain was associated with greater child self- and parent-reported internalizing

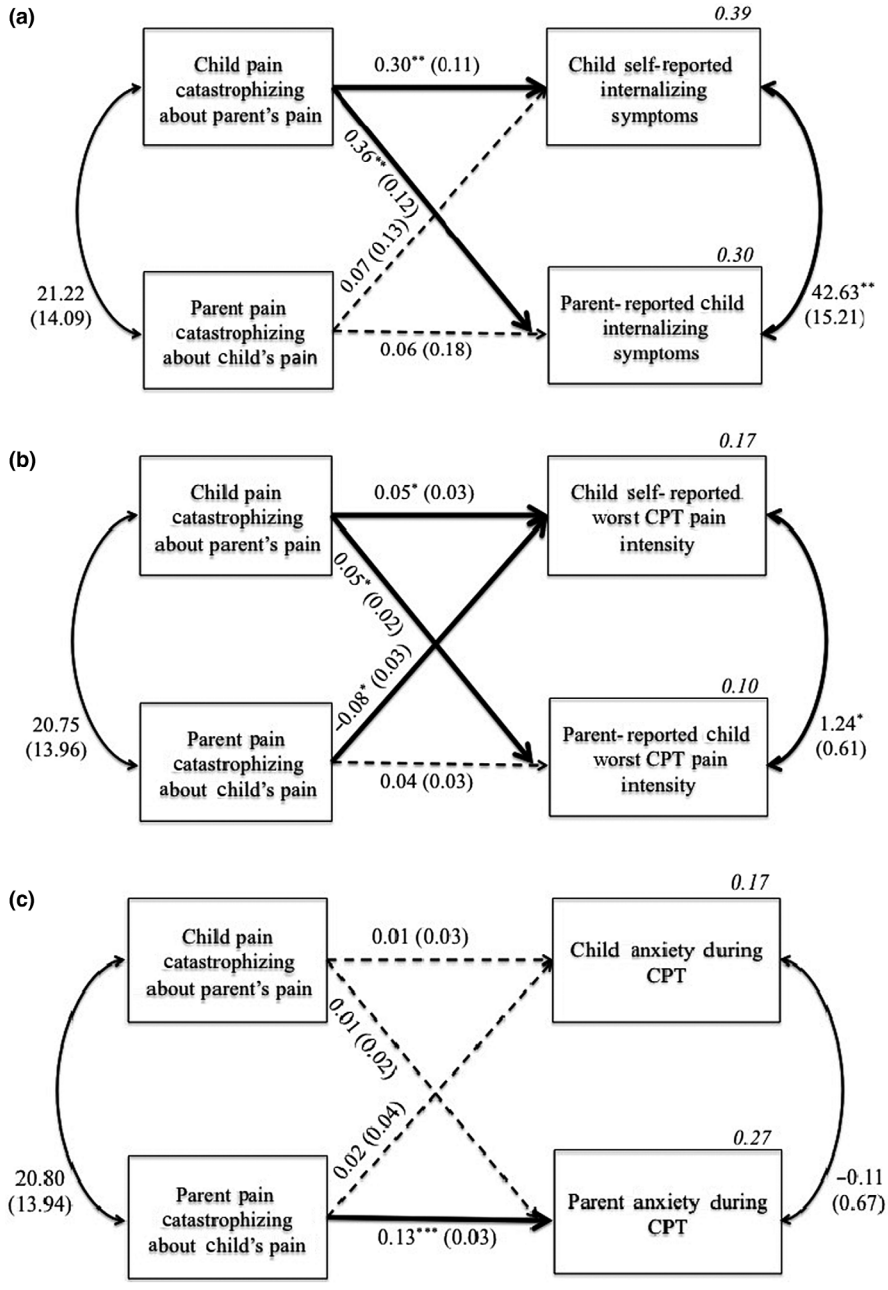

Figure 2. APIM Analyses of Child and Parent Catastrophizing About Each Other's Pain Predicting Study Outcomes. Unstandardized coefficients and standard errors are presented. Bold lines indicate significant effects; dotted lines indicate non-significant effects. *$p < .05$, **$p < .01$, ***$p < .001$

symptoms and CPT pain intensity, beyond associations with children's and parents' catastrophizing about their own pain. Regarding secondary hypotheses, greater parent catastrophizing about child pain was associated with lower child self-reported CPT pain intensity. Child and parent catastrophizing about the child's pain were associated with

their own anxiety during the CPT. Only child and parent catastrophizing about their own pain were associated with their own usual intensity of their most common pain in the previous 3 months.

These results extend the existing literature on the intra- and interpersonal effects of pain catastrophizing in parents and children. Higher levels of parent catastrophizing about their own pain were associated with greater child catastrophizing about parent pain. Greater parent catastrophizing about their own pain has been associated with negative child pain-related outcomes in other studies (Pagé *et al.*, 2013; Vervoort *et al.*, 2013). As theorized, greater parent catastrophizing about their own pain may influence the behaviours they use in expressing and coping with their own pain, communicating higher threat value of pain to their children (Stone & Wilson, 2016). This may result in children's increased catastrophizing about their parent's pain.

Children's higher catastrophizing about parent pain was associated with poorer child self- and parent-reported outcomes (internalizing symptoms and CPT pain intensity) beyond children's catastrophizing about their own pain. It is theorized that children learn from parents with chronic pain (e.g., through modelling or reinforcement) to appraise their own pain as threatening, and these cognitions make children vulnerable to poor pain-related outcomes (Stone & Wilson, 2016). Observing others in pain is associated with negative observer outcomes including self-oriented distress (e.g., internalizing symptoms; Goubert *et al.*, 2005). This may be particularly evident in children, for whom it is adaptive to appraise situations impacting a parent's ability to meet the child's needs (e.g., chronic pain) as particularly threatening (Mikail, Henderson, & Tasca, 1994). This may result in unique impacts on children beyond cognitions about their own pain.

Consistent with the robust literature on the intrapersonal effects of catastrophizing about one's own pain (Buenaver *et al.*, 2008; Craner *et al.*, 2017; Durand *et al.*, 2017; Fisher *et al.*, 2017), greater parent and child catastrophizing about their own pain were associated with higher usual pain intensity over the previous 3 months. Higher child catastrophizing about their own pain was also associated with greater child anxiety during the CPT. Contrary to research in parents of children with and without chronic pain (Birnie *et al.*, 2016; Goubert *et al.*, 2009; Wilson *et al.*, 2014), few interpersonal effects of parental catastrophizing about child pain on child outcomes were found. Only an interpersonal association in the opposite direction from what was expected was found in the context of the CPT, with increased parent catastrophizing about child pain being associated with decreased child self-reported worst pain intensity. Different relationships may exist between parent catastrophizing about child pain and child pain outcomes in children of parents with chronic pain compared to other samples. Children have reported hiding their distress to avoid upsetting parents with chronic pain (Evans & de Souza, 2008; Umberger, Risko, & Covington, 2015) and may similarly hide their pain, particularly when their parents have higher trait catastrophizing about the child's pain. Alternatively, with higher parent catastrophizing about child pain, children may feel confident that their pain will be recognized and managed, leading to decreased pain expression. Increased parent catastrophizing about child pain has been associated with greater parent–child congruence in rating children's pain (Goubert *et al.*, 2009).

This study makes an important contribution to the literature on children of parents with chronic pain and the knowledge base on pain catastrophizing. It identifies a new construct of interest and makes use of a modified version of a well-established measure (Goubert *et al.*, 2006). The modified measure showed strong internal consistency and a three-factor structure, and correlations with expected variables (e.g., parent pain interference, child ratings of parent relationship importance) were observed suggesting

preliminary evidence of concurrent validity. Strong study methodology was employed, including the use of reliable and valid measures, multi-informant outcome measurement, and use of experimental pain methodology to study children's immediate (rather than retrospective) pain experiences. Dyadic data analysis techniques were used to appropriately account for non-independence in the parent–child data.

Our study must be interpreted in the context of its limitations. Given the cross-sectional design, directions of the observed relationships cannot be determined. Assessment of child catastrophizing about parent pain used a measure modified from one created for parents to report on their catastrophizing about child pain (Goubert *et al.*, 2006), and further study is needed to determine its validity and factor structure. Only trait catastrophizing was examined, and parents' and children's trait and state catastrophizing may have differential effects (Durand *et al.*, 2017). Though the child pain interview (Petter *et al.*, 2013) likely assisted children in establishing the relevant timeline, social desirability may have influenced responses. The sample was homogeneous (mostly mothers and identifying as white) and the generalizability of results to other groups is unknown.

Further study of child catastrophizing about parent chronic pain is needed to better understand this potential vulnerability factor. Qualitative studies seeking to understand children's experiences of catastrophizing about their parents' chronic pain could assist with improving the measure, interpreting quantitative results, and understanding how child catastrophizing might change across developmental stages. Additionally, studies comparing child catastrophizing about parent pain among children of parents with and without chronic pain may assist in testing social learning theories underlying the intergenerational transmission of pain. Prospective, longitudinal studies are needed to clarify the temporal relationships between parent and child catastrophizing about their own and each others' pain and their effects on children's outcomes. Improved understanding of how children's trait catastrophizing develops in the context of parental chronic pain is needed. Child catastrophizing about parent pain is likely impacted by child development, dispositional empathy (Goubert *et al.*, 2005), and parent–child attachment (Donnelly & Jaaniste, 2016). Incorporation of these variables in future work will assist in clarifying their impacts on child pain catastrophizing.

While the role of child catastrophizing about parent pain as a risk factor needs to be clarified, it may be an important target for prevention and intervention programmes. If this is confirmed, screening for high levels of catastrophizing about a parent's chronic pain could identify children in need of increased support. Interventions to decrease child catastrophizing about parent pain could be developed based on interventions for decreasing catastrophizing about one's own pain (Schütze *et al.*, 2018) or decreasing anxiety in children of parents with other chronic illnesses (e.g., Scholten *et al.*, 2013). Parents have expressed concern about how their chronic pain impacts their children (Evans & de Souza, 2008; Umberger *et al.*, 2015), and providing education and evidence-based strategies to mitigate these effects could empower parents in improving child outcomes. While further research is needed, child catastrophizing about parental chronic pain is a potential risk factor that could play a role in improving outcomes in this vulnerable population.

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Conflicts of interest

All authors declare no conflict of interest.

Data availability statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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Supporting Information

The following supporting information may be found in the online edition of the article:

Appendix S1. Exploratory factor analysis.