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It's All Relative: Parent Pain-Related Distress and Acceptance as Predictors of Youth Outcomes in Chronic Pain Dyads

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Abstract

Parent emotional and behavioral responses play a critical role in shaping youth pain-related outcomes, yet little research has examined these processes day-to-day overtime. This study investigated the contemporaneous and temporal associations between child pain intensity, pain-related distress, and child functional impairment and parent pain-related distress, protective behaviors, and pain acceptance in a sample of youth with chronic pain and their parents. Daily assessments were collected from 68 youth-pared dyads participating in a study investigating a multi-modal intervention for chronic pain. Longitudinal Actor-Partner Interdependence Models (L-APIMs) were used to examine within-day and next day associations for child and parent variables. Within the same day, higher parent pain-related distress was associated with greater child pain-related distress (β = 0.10, p = 0.001), as well as increased parent protective behaviors (β = 0.44, p < 0.001). Increased parent pain acceptance was associated with decreased child functional impairment (β = 0.15, p <0.001) and protective behaviors (β = -0.09, p = 0.03). Next-day analyses revealed that higher parent pain acceptance predictors lower child pain-related distress and parent protective behaviors. Child pain reductions predicted lower functional impairment and fewer parent protective behaviors the next day. Findings highlight the importance of targeting parent psychological processes, particularly distress and pain acceptance, in pediatric chronic pain interventions. Addressing parent distress and fostering pain acceptance may lead to improvements in both child and parent outcomes, reinforcing the value of dyadic, acceptance-based approaches in pediatric pain treatment.

Introduction

Pediatric chronic pain affects 20-30% of adolescents. It is known that emotional distress in youth and parents is associated with greater pain severity and functional impairment in youth [6; 7; 16; 28]. Importantly, parents' psychological responses, including their own pain-related distress, are also known to drive maladaptive protective behaviors (e.g., excessive monitoring, activity restriction), which can reinforce pain-related avoidance and functional impairment in youth [7; 11].

Previous work has emphasized that parent psychological flexibility (i.e., the ability to maintain values-based actions despite difficult internal experiences) buffers maladaptive responses[1; 11]. Specifically, greater parent psychological flexibility is predictive of less protective behavior and increased activity engagement in youth [1]. However, these studies utilized cross-sectional or longitudinal data collected at major timepoints (e.g., baseline, 3-month follow-up). While these methodologies allow for an examination of associations between youth and parent variables, they are limited in their ability to untangle the nuances in day-to-day associations between child and parent variables over time.

Studies leveraging daily assessments have begun to illuminate these dynamic processes, demonstrating greater parent protective behaviors are associated with increased pain intensity and functional impairment [4]. Additionally, parent behaviors vary throughout the day and appear to be driven by child pain intensity in the moment. Similarly, greater negative mood in parents has been associated with higher parent protective behaviors, which are associated with increased youth pain intensity and functional impairment [17]. Moreover, youth with high baseline catastrophizing exhibit a stronger association between parent mood and pain-related

outcomes in youth, while parent pain catastrophizing was linked to a weaker association between parent protective behaviors and youth functional impairment [17], suggesting that other mechanisms (e.g., parent pain-related fear, pain acceptance) may be driving parent protective behaviors and functional impairment in youth.

The present study aimed to further our understanding of the dyadic relationship between youth with chronic pain and their parents by examining contemporaneous (within-day) and temporal (next-day) associations using intensive longitudinal data. This study utilized a sample of youth and parents participating in a multimodal intervention for chronic pain. We hypothesized that, within the same day, higher child pain intensity and pain-related distress would be associated with greater child functional impairment and increased parent protective behaviors. Similarly, greater parent pain-related distress and lower parent pain acceptance would be associated with greater child pain-related distress, child functional impairment, and parent protective behaviors. For temporal associations, we hypothesized that higher levels of parent pain-related distress and protective behaviors, and lower parent pain acceptance, would predict greater child pain-related distress and functional impairment the following day.

Methods

Participants

Youth were eligible if they were 1) between the ages for 10-18 years old, 2) had musculoskeletal pain (e.g., localized [back, limb] or diffuse) not due to an acute trauma (active sprain or fracture); 3) moderate to high pain-related fear (Fear of Pain Questionnaire- FOPQ-C] ≥ 35)[21]; 4) moderate to high functional disability (Functional Disability Inventory ≥ 13)[13]; and 5) proficiency in the English language. Youth were ineligible if they reported 1) significant

cognitive impairment (e.g., brain injury) or 2) significant medical or psychiatric problem that would interfere with treatment (e.g., active psychosis, seizures, suicidality).

Procedures

All study procedures were approved by the institutional review board (Stanford University IRB Protocol # 39514). The current investigation utilizes daily assessment collected from a sample of participants who were enrolled in an examination of a multi-modal intervention (e.g., pain psychology and physical therapy) for chronic pain[19]. Of note, the original investigation compared an intervention where cognitive behavioral therapy (CBT) and physical therapy (PT) were jointly delivered to a control arm where CBT and PT were delivered separately. As there were no differences between the two treatment arms, the two samples from the original investigation were examined together in the current study.

The sample included youth and a parent recruited from a tertiary pain clinic in the Western United States between January 2019 to May 2021. Once deemed eligible, youth were enrolled and were randomized to a baseline period (ranging 7-25 days) during which daily data were collected. Following the baseline phase, youth and parents began the intervention phase, during which they received outpatient pain psychology and physical therapy delivered twice weekly. Youth and parents completed daily assessments throughout the intervention (~6 weeks) and for seven days at 3-and 6-month follow-up time points [20]. All daily assessments were administered using Research Electronic Data Capture (REDCap). Items were presented in a random order each day to reduce response bias.

Measures

Demographic and Pain Characteristics

Youth and one parent reported on demographic variables including age, sex assigned at birth, race, and ethnicity. Pain characteristics (e.g., onset, duration, and intensity) were also collected. Youth reported daily pain using a single-item 0-10 Numeric Rating Scale (NRS), anchored at 0 = no pain to 10 = worst pain possible.

Daily Measures of Parent and Child Pain-related Distress and Behavior

Daily assessments of youth pain, pain-related distress, and functional impairment, as well as parent emotional and behavioral functioning in the context of their child's pain, were administered. To minimize burden while maintaining construct validity, each domain was assessed using a brief set of items from established and validated measures (described below). Items were adapted slightly for daily administration and rated using a 0-10 NRS from 0 (strongly disagree) to 10 (strongly agree). Composite scores for each construct were computed by averaging item responses within each day. Internal consistency for each composite score was evaluated using multilevel Omega coefficients (within- and between-person) reported in Table 1.

Child pain-related distress was assessed using one item from the Pain Catastrophizing Scale for Children (PCS-C)[5] and one item from the Fear of Pain Questionnaire for Children (FOPQ-C)[21]. The PCS-C assesses maladaptive cognitive and emotional responses to pain and demonstrated good internal reliability (α = .87)[5]. The FOPQ-C measures pain-related fear and activity avoidance and demonstrates excellent reliability (α = .92)[21].

Child functional impairment was assessed using three items from the Functional Disability Inventory (FDI)[26], two items from the Fear of Pain Questionnaire for Children (FOPQ-C)[21], and two items from the Chronic Pain Acceptance Questionnaire (CPAQ-8)[8]. The FDI assesses perceived difficulty in physical and social activities due to health concerns and demonstrates

excellent reliability (α = .91)[26]. The CPAQ assesses willingness to experience pain and engage in activities despite having pain and demonstrates excellent reliability (α = .91)[8].

Parent pain-related distress was assessed using one item from the Parent Fear of Pain Questionnaire (PFOPQ)[22], one item from the Pain Catastrophizing Scale for Parents (PCS-P)[10], and one item from the Parent Pain Acceptance Questionnaire (PPAQ)[23]. The PFOPQ measures parents' pain-related fear and avoidance of activities in the context of their child's pain and demonstrates good reliability (α = .89)[22]. The PCS-P examines how much a parent catastrophizes about their child's pain experience and demonstrates excellent reliability (α = .91)[10]. The PPAQ assesses parent's acceptance of their child's pain and willingness to support them in functional activities despite the presence of pain and demonstrates good reliability (α = .82)[23].

Parent pain acceptance was assessed using two items from the Parent Pain Acceptance Questionnaire (PPAQ)[23]. Parent protective behaviors were assessed using two items from the Adult Responses to Children's Symptoms (ARCS)[25]. The ARCS assesses how parents respond to their child's pain and demonstrates good reliability (α = .84).

Table 1. Daily assessment items used to create constructs

Construct		Within-person Omega	Between-person Omega
Child pain-related distress		0.71	0.92
	"I spent a lot of time worrying about my pain"[a]		
	"I felt sad or frustrated because of my pain." [b]		
Child functional Impairment		0.80	0.96
	"I skipped activities because of my pain"[a]		
	"I did not make plans because of my pain"[a]		
	"I was less active than usual because of my pain"[c]		
	"It was difficult to focus or concentrate because of my pain"[c]		
	"It was difficult to spend time with my friends because of my pain"[c]		
	"I did the things that were fun or important to me even though I had pain."[d] *		
	"I did the things I had to do while having pain." [d] *		
Parent pain-related distress		0.80	0.97
	"My child's pain was overwhelming to me."[e]		
	"I felt I couldn't help my child when they were in pain"[f]		
	"I found it difficult to tolerate my child's suffering"[g]		
Parent Acceptance		0.66	0.99
	"I encouraged my child to do things that were fun or important to them regardless of their pain"[g]		
	"I encouraged my child to do things they had to do regardless of their pain."[g]		
Parent Protective Behaviors		0.64	0.92
	"I let my child sleep more than usual due to their pain."[h]		
	"I spent more time than usual with my child because of their pain."[h]		

Note: [a]Fear of Pain Questionnaire Child (FOPQ-C); [b]Pain Catastrophizing Scale-Child (PCS-C); [c]Functional Disability Inventory (FDI); [d]Chronic Pain Acceptance Questionnaire; [e]Parent Fear of Pain Questionnaire (PFOPQ); [f]Pain Catastrophizing Scale, Parent (PCS-P); [g]Parent Pain Acceptance Questionnaire; [h]Adult Responses to Children's Symptoms (ARCS, Protect subscale)*items reverse scored

Data Analysis Plan

The data has a two-level structure: for each dyadic partner (youth and their parent) repeated measurements occasions are nested within person (i.e., both child and parent were measured each day). To account for the nested data structure and for the interdependence between youth and their parent, we used Longitudinal Actor and Partner Interdependence Models (L-APIMs)[9; 14]. L-APIMs are used to examine how the outcome of each dyadic partner is contemporaneously or temporally linearly related to their own and their partners predictor values. Specifically, L-APIM allows for examination of contemporaneous (i.e., within the same day) or lagged (i.e., based on the measurement of the previous day) actor and partner effects of the youth independent variable X^C and the parent independent variable X^P, on the youth dependent variable Y^C and parent dependent variable Y^P. This allows the two actor and partner effects to differ between the youth and parent (i.e., implying distinguishable partners). Both the actor and partner effects were introduced as fixed effects and the predictor variables X^C and X^P

were person-mean centered. L-APIM models are ideally suited for modeling bidirectional and time-ordered associations between dyadic partners over time. This analytic framework allows simultaneous estimates of both actor effects (i.e., how a person's own characteristics influence their outcomes) and partner effects (how the other person's characteristics influence their outcomes), within and across days, while accounting for non-independence within dyads and repeated observations.

To account for missing data, all models were estimated using restricted maximum likelihood (REML), which accommodates unbalanced data and missingness under the assumption that data are missing at random[12]. No imputation procedures were used. All available daily diary entries were included in the analyses, and no minimum number of daily entries were required for inclusion as L-APIMS can handle unequal numbers of observations per participant. Although the number of daily responses varied widely across dyads (range 13-168), this variation was accommodated via random effects, and sensitivity analyses confirmed that no single dyad unduly influenced model estimates. These multiverse analyses, described in the supplemental material, also examined different thresholds for classifying delayed responses (e.g., entries submitted after midnight), and the results were robust across thresholds.

To investigate the effect of the treatment we included in the models a dummy variable which equals zero for measurement occasions in the baseline phase and equal to one in the treatment phase. To model potential trends in the outcome variables, we included time (t) as a variable indexing the day within each baseline and intervention assessment phases. To make the intercepts interpretable, we transformed the time variable (corresponding to days) such that this variable started at zero within each of the baseline and intervention phase. The model also

includes the interaction between the intervention assessment phase and time. These models included random effects for the intercepts, for the slope for the effect of time (t), and the interaction of time (t) with the phase variable. To account for remaining dependencies between both dyadic partners, the models assume correlated Level 1 errors between youth and parent and correlated random effects. This model imposes two additional assumptions on the Level 1 errors: the variance and covariance are stable over time and over dyads. Figures 1 and 2 shows the L-APIMs that were used to investigate the temporal and contemporaneous relations between the child and parent variables.

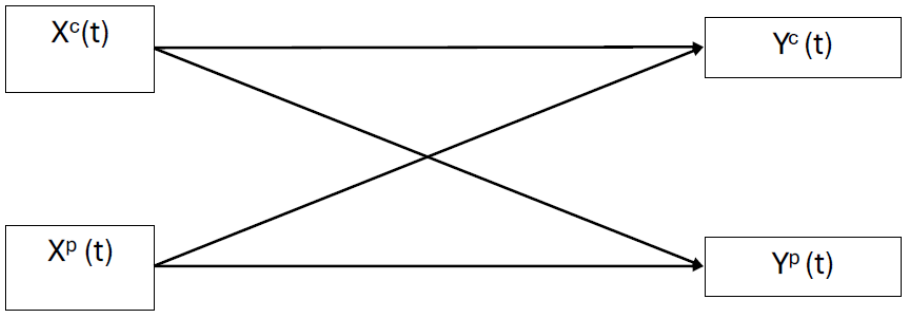


Figure 1: L-APIM model used to examine how the outcome for each dyadic partner is contemporaneously (within the same day) related to their own and their partners predictor variables. Within this model, X^c and Y^c represent the independent and dependent, respectively, variables for the child. X^p and Y^p represent the independent and dependent, respectively, variables for the parent; (t) represents time point (i.e., day).

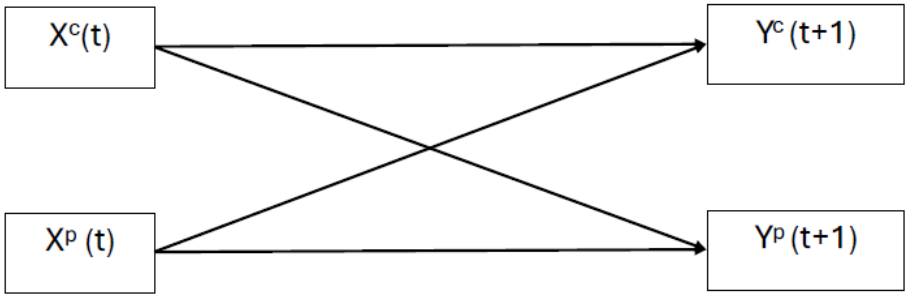


Figure 2: L-APIM model used to examine how the outcome for each dyadic partner is temporally (i.e., the following day) related to their own and their partners predictor variables. Here, X^c and Y^c represent the independent and dependent, respectively, variables for the child and X^p and Y^p

represent the independent and dependent, respectively, variables for the parent; (t) represents time point (i.e., day), with t + 1 representing the following day.

Analyses were conducted using R version 4.0.3 (R Core Team, 2020). L-APIMs were estimated using mixed-effects models using the R package nlme version 3.1-159 (Pinheiro, Bates and R Core Team, 2022) and the package optimix version 2022-4.30 (Nash & Varadhan, 2011). We used multilevelTools version 0.1.1 (Wiley, 2020) to compute omega reliability scores. We also use the functionality of the R package tidyverse version (Wickham et al., 2019) for data wrangling and data transformation. We used R package sjPlot version 2.8.11 (Wickham2016) and htmltools version 0.5.3 (Cheng et al., 2022) to create tables and plots which are included in the supplementary material. All analyses of the current study were registered on the Open Science Framework (OSF) post-data collection but prior to data access (https://osf.io/m5ept). All relevant code and materials have been made available online on the OSF-project for this study (https://osf.io/4k6wq/).

Results

Descriptive Statistics

Demographic data and descriptive statistics for the sample (*N* = 68 dyads) are presented in Table 2. Youth were predominantly females (95.5%) and White (80.8%%). Mean age of youth was 14.1 years. Most youth reported a diagnosis of musculoskeletal pain (86.7%) and an average pain intensity of 4.88 (SD = 2.7). Most parents identified as mothers (91.4%), with 57.4% reporting a history of chronic pain and 45.6% reporting current chronic pain. Youth-parent dyads completed, on average, 65.4 daily assessments (SD = 21.90; Range = 13-168).

Descriptive analyses indicated that the daily diary constructs demonstrated meaningful day-to-day variability. Youth-reported pain intensity ranged from 0 to 10 (M = 4.35, SD = 2.31;

Table 2), with an average within-person standard deviation of 1.65 (range = 0.58 – 3.89; Table 1). Child pain-related distress (M = 4.01, SD = 2.16, Table 2) also showed high daily fluctuation (within-person standard deviation = 1.52, range = 0.60 – 3.40; Table 1). Child functional impairment (within-person standard deviation = 1.51), parent protective behavior (within-person standard deviation = 1.53), and parent pain-related distress (within-person standard deviation = 1.31) also demonstrated moderate within-person variability (Table 1). Within-person standard deviation for parent pain acceptance was low (1.15). Intraclass correlation coefficients demonstrated that 50-65% of the variance in constructs occurred within individuals across days (Table 1), supporting the use of a daily diary approach to capture dynamic parent-child interactions.

Table 2. Child and Parent demographic and medical characteristics

		N = 68	
Variable	Range	Mean (*SD*)	Frequency % (n)
Child Characteristics			
Age (years)	8-18	14.1 (2.9)	
Female			80.5% (55)
Ethnicity			
Latinx			23.5 (16)
Not Latinx			76.5 (52)
Race			
White			80.8 % (55)
Black or African American			4.4 % (3)
Asian			1.5% (1)
Not above			11.8% (8)
Primary Pain Diagnosis			
Musculoskeletal			86.7% (59)
Abdominal			7.35% (5)
Duration of Pain (months)	0-197		
Typical Pain rating*	0-10	4.88 (2.7)	
Caregiver Characteristics			
Relationship to child			
Mother			32 (91.4%)
Age (years)	34-63	46.9 *(6.14)*	
Ethnicity			
Hispanic or Latino			17.6% (12)
Not Hispanic or Latino			77.9% (53)
Unknown			2.9% (2)
Caregiver Pain History			
History of chronic pain			57.4% (39)
Current chronic pain			45.6% (31)

Note. *Typical pain reported is the numerical rating collected at the baseline assessment

Examination of Relationships Between Child and Parent Variables

The dyadic relationship between youth with chronic pain and their parents by examining contemporaneous (within-day) and temporal (next-day) associations using a longitudinal Actor-Partner Interdependence Model (L-APIM) framework. All models were controlled for time, treatment phase, and key interaction effects, and all tested both actor (youth) and partner (parent) pathways. A multiverse analysis, detailed in the supplemental materials, confirmed that results were robust across different thresholds.

Contemporaneous Relationships Between Child and Parent Variables

First, we tested contemporaneous, or within the same day, associations between parent and child variables. Results of the L-APIM analyses are shown in Table 3 and Figure 3.

Table 3. Contemporaneous relationships between child and parent variables

Model	Dependent variables (t)	Independent variables (t)	Estimates β	95% CI	p
1	Child pain-related distress	Child pain	3.18	[2.33, 4.04]	**<0.001**
		Child pain*Phase	0.22	[-0.83, 1.27]	0.677
		Parent pain-related distress	0.10	[0.01, 0.19]	**0.032**
		Parent pain-related distress*Phase	0.02	[-0.08, 0.13]	0.679
	Parent protective behavior	Child pain	0.80	[-0.00, 1.60]	0.051
		Child pain*Phase	-0.13	[-1.10, 0.84]	0.796
		Parent pain-related distress	0.44	[0.36, 0.53]	**<0.001**
		Parent pain-related distress*Phase	-0.03	[-0.13, 0.07]	0.576
2	Child pain-related distress	Child pain	3.24	[2.38, 4.10]	**<0.001**
		Child pain*Phase	0.20	[-0.85, 1.25]	0.713
		Parent pain-related distress	0.11	[0.02, 0.20]	**0.017**
		Parent pain-related distress*Phase	0.01	[-0.09, 0.12]	0.817
	Parent acceptance	Child pain	-0.47	[-1.20, 0.26]	0.204
		Child pain*Phase	-0.55	[-1.45, 0.34]	0.224
		Parent pain-related distress	-0.09	[-0.16, -0.01]	**0.030**
		Parent pain-related distress*Phase	0.09	[0.00, 0.18]	0.049

In Model 1, results demonstrate greater child pain intensity was significantly associated with greater child pain-related distress in the same day ($\beta = 3.18$, $p < 0.001$, 95% CI [2.33, 4.04]). No significant association between child pain intensity and parent protective behavior was found. Greater parent pain-related distress was associated with greater child pain-related distress ($\beta = 0.10$, $p = 0.032$, 95% CI [0.01, 0.19] and greater parent protective behaviors in the same day ($\beta = 0.44$, $p < 0.001$, 95% CI [0.36, 0.53].

In Model 2, greater child pain intensity was associated with greater child pain-related distress in the same day ($\beta = 3.24$, $p < 0.001$, 95% CI [2.38, 4.10]). No significant association between child pain intensity and parent pain acceptance was found. Greater parent pain-related distress was associated with greater child pain-related distress ($\beta = 0.11$, $p = 0.017$, 95% CI [0.02, 0.20] and lower parent pain acceptance in the same day ($\beta = -0.09$, $p = 0.03$, 95% CI [-0.16, -0.01].

In Model 3, greater child pain-related distress was significantly associated with greater child functional impairment ($\beta = 0.28$, $p < 0.001$, 95% CI [0.22, 0.34]) and greater parent

protective behaviors (β = 0.12, p = 0.001, 95% CI [0.05, 0.19]) in the same day. Greater parent pain-related distress was associated with greater child functional impairment (β = 0.16, p < 0.001, 95% CI [0.08, 0.23] and greater parent protective behaviors in the same day (β = 0.45, p < 0.001, 95% CI [0.37, 0.54].

In Model 4, greater child pain-related distress was significantly associated with greater child functional impairment (β = 0.28, p < 0.001, 95% CI [0.22, 0.34]) and lower parent pain acceptance in the same day (β = 0.09, p = 0.01, 95% CI [0.02, 0.16]). Greater parent pain-related distress was associated with greater child functional impairment in the same day (β = 0.15, p < 0.001, 95% CI [0.07, 23]). No significant association was found between parent pain-related distress and parent acceptance in the same day.

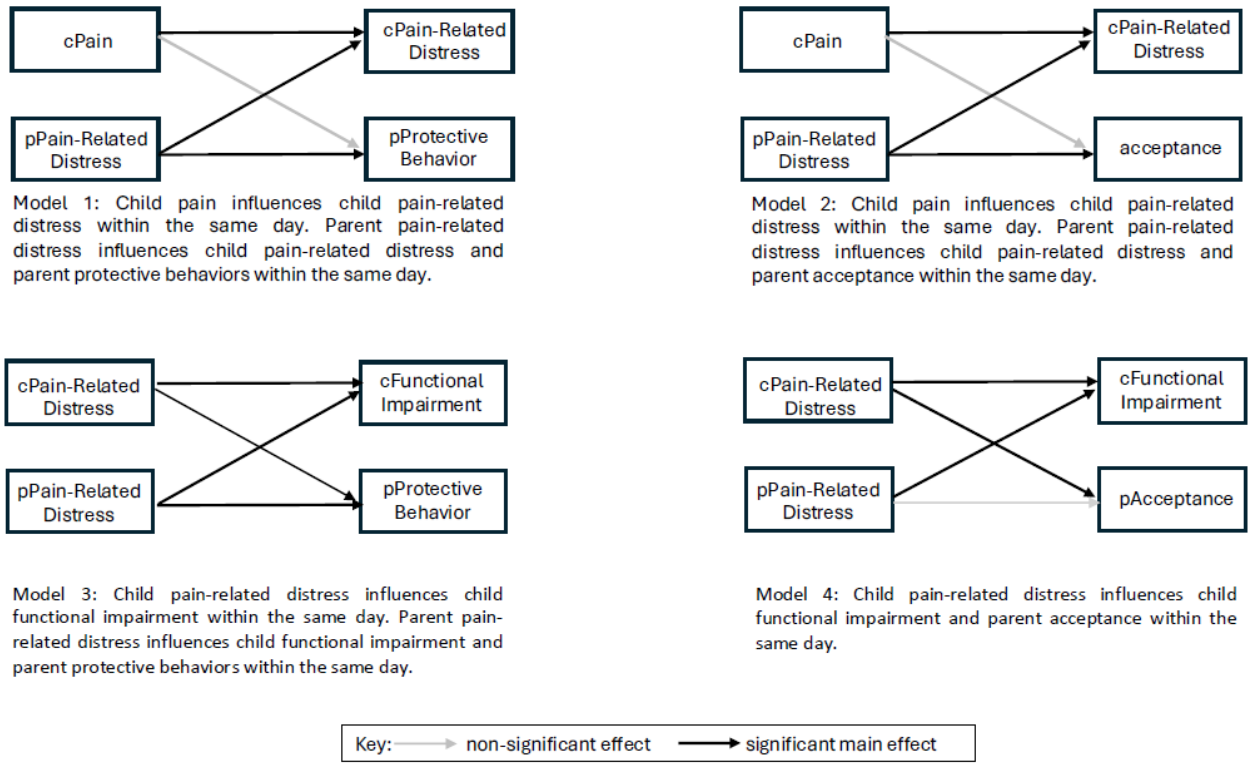


Figure 3: Contemporaneous relationships between child and parent variables.

Temporal Relationships Between Child and Parent Variables

Following examination of contemporaneous effects, we examined whether daily variables predicted outcomes the following day (i.e., temporal relationships). The results of the L-APIMs investigating temporal associations between the youth and parent variables are included in Table 4 and in Figure 4.

Table 4. Temporal relationships between child and parent variables

Model	Dependent variables (t+1)	Independent lagged variables (t)	Estimates β	95% CI	p
5	Child pain-related distress	Child pain	0.57	[-0.37, 1.52]	0.233
		Child pain*Phase	0.97	[-0.19, 2.13]	0.103
		Parent pain-related distress	-0.07	[-0.17, 0.02]	0.126
		Parent pain-related distress*Phase	0.10	[-0.02, 0.21]	0.093
	Parent protective behavior	Child pain	1.73	[0.83, 2.63]	**<0.001**
		Child pain*Phase	-1.10	[-2.18, -0.02]	**0.047**
		Parent pain-related distress	0.08	[-0.02, 0.17]	0.134
		Parent pain-related distress*Phase	0.03	[-0.08, 0.15]	0.588
6	Child functional impairment	Child pain	1.00	[0.21, 1.78]	**0.013**
		Child pain*Phase	0.02	[-0.92, 0.97]	0.959
		Parent pain-related distress	0.02	[-0.06, 0.10]	0.632
		Parent pain-related distress*Phase	-0.03	[-0.13, 0.06]	0.523
	Parent protective behavior	Child pain	1.86	[0.96, 2.75]	**<0.001**
		Child pain*Phase	-1.18	[-2.26, -0.10]	**0.032**
		Parent pain-related distress	0.08	[-0.02, 0.17]	0.130
		Parent pain-related distress*Phase	0.03	[-0.09, 0.14]	0.632
7	Child pain-related distress	Child pain	0.49	[-0.43, 1.41]	0.297
		Child pain*Phase	1.02	[-0.11, 2.15]	0.078
		Parent acceptance	0.03	[-0.06, 0.13]	0.517
		Parent acceptance*Phase	-0.07	[-0.19, 0.04]	0.224
	Parent protective behavior	Child pain	1.77	[0.89, 2.65]	**<0.001**
		Child pain*Phase	-1.02	[-2.08, 0.04]	0.060
		Parent acceptance	0.10	[0.01, 0.19]	**0.034**
		Parent acceptance*Phase	-0.14	[-0.25, -0.03]	**0.014**

Note. Statistically significant (α = .05) p-values across the five preprocessing choices are marked in bold.

Table 4 (continued). Temporal relationships between child and parent variables

Model	Dependent variables (t+1)	Independent lagged variables (t)	Estimates β	95% CI	p
8	Child functional impairment	Child pain	0.95	[0.19, 1.72]	**0.014**
		Child pain*Phase	-0.06	[-0.98, 0.86]	0.892
		Parent acceptance	0.01	[-0.07, 0.09]	0.767
		Parent acceptance*Phase	-0.05	[-0.15, 0.05]	0.345
	Parent protective behavior	Child pain	1.90	[1.02, 2.78]	**<0.001**
		Child pain*Phase	-1.12	[-2.17, -0.06]	**0.038**
		Parent acceptance	0.10	[0.01, 0.19]	**0.034**
		Parent acceptance*Phase	-0.14	[-0.25, -0.03]	**0.014**
9	Child functional impairment	Child pain-related distress	0.03	[-0.05, 0.11]	0.444
		Child pain-related distress*Phase	0.04	[-0.05, 0.14]	0.376
		Parent pain-related distress	0.02	[-0.06, 0.10]	0.642
		Parent pain-related distress*Phase	-0.02	[-0.12, 0.07]	0.644
	Parent protective behavior	Child pain-related distress	0.04	[-0.04, 0.12]	0.298
		Child pain-related distress*Phase	0.01	[-0.09, 0.10]	0.854
		Parent pain-related distress	0.15	[0.05, 0.25]	**0.004**
		Parent pain-related distress*Phase	-0.04	[-0.16, 0.08]	0.498
10	Child functional impairment	Child pain-related distress	0.04	[-0.04, 0.12]	0.331
		Child pain-related distress*Phase	0.03	[-0.06, 0.13]	0.513
		Parent acceptance	-0.01	[-0.09, 0.07]	0.861
		Parent acceptance*Phase	-0.05	[-0.15, 0.05]	0.286
	Parent protective behavior	Child pain-related distress	0.07	[-0.01, 0.15]	0.107
		Child pain-related distress*Phase	0.00	[-0.10, 0.09]	0.986
		Parent acceptance	0.09	[-0.00, 0.17]	0.057
		Parent acceptance*Phase	-0.13	[-0.24, -0.03]	**0.016**

Note. Statistically significant (α = .05) p-values across the five preprocessing choices are marked in bold.

In Model 5, greater child pain intensity significantly predicted greater parent protective behaviors the follow day (β = 1.73, p < 0.001, 95% CI [0.83, 2.63]). However, this relationship was significantly moderated by treatment phase, such that associations between child pain and next-day parent protective behaviors was attenuated during the intervention compared to baseline (β = -1.10, p < 0.047, 95% CI [-2.18, -0.02]). No signification associations were found between child pain intensity and child pain-related distress the following day. No significant associations were found between parent pain-related distress and child pain-related distress or parent protective behaviors the following day.

In Model 6, greater child pain intensity significantly predicted greater child functional impairment the following day (β = 1.00, p = 0.01, 95% CI [0.21, 1.78]). Greater child pain was also predictive of greater parent protective behaviors the following day (β = 1.86, p < 0.001, 95% CI

[0.96, 2.75]). However, this relationship was significantly moderated by treatment phase, such that associations between child pain and next-day parent protective behaviors was attenuated during the intervention compared to baseline (β = -1.18, p = 0.32, 95% CI [-2.26, -0.10]). No significant associations were found between parent pain-related distress and child pain-related distress or parent protective behaviors the following day.

In Model 7, greater child pain intensity significantly predicted greater parent protective behaviors the following day (β = 1.77, p < 0.001, 95% CI [0.89, 2.65]). Greater parent pain acceptance was significantly predictive of lower parent protective behaviors the following day ((β = 0.20, p = 0.03, 95% CI [0.01, 0.19]), and this effect was moderated by treatment phase (β = -0.14, p = 0.01, 95% CI [-0.25, -0.03]). No significant associations were found between child pain intensity and parent pain acceptance on child pain-related distress the following day.

In Model 8, greater child pain intensity was predictive of greater child functional impairment the following day (β = 10.95, p = 0.01, 95% CI [0.19, 1.72]). Greater child pain intensity also significantly predicted greater parent protective behaviors the following day (β = 1.90, p < 0.001, 95% CI [1.02, 2.78]). This relationship was significantly moderated by treatment phase (β = -1.12, p = 0.03, 95% CI [-2.17, -0.06]), indicating that parents were less likely to engaged in protective behaviors during the intervention. Additionally, greater parent pain acceptance significantly predicted less parent protective behaviors the following day (β = 0.10, p = 0.03, 95% CI [0.01, 0.19]), and this effect was also stronger during treatment (β = -0.14, p = 0.01, 95% CI [-0.25, -0.03]). No significant associations were found between parent pain acceptance and child functional impairment the following day.

In Model 9, parent pain-related distress significantly predicted greater parent protective behaviors the following day (β = 0.15, p = 0.004, 95% CI [0.05, 0.25]). However, child pain-related distress was not significantly associated with next-day child functional impairment or parent protective behaviors. Parent pain-related distress was also not associated with next-day child functional impairment.

In Model 10, no significant main effects were observed. However, the interaction between parent pain acceptance and treatment phase for next-day parent protective behaviors was significant (β = -0.13, p = 0.01, 95% CI [-0.24, -0.03]), suggesting that the influence of parent acceptance on protective behavior was stronger during treatment. No significant associations emerged for child functional impairment in this model.

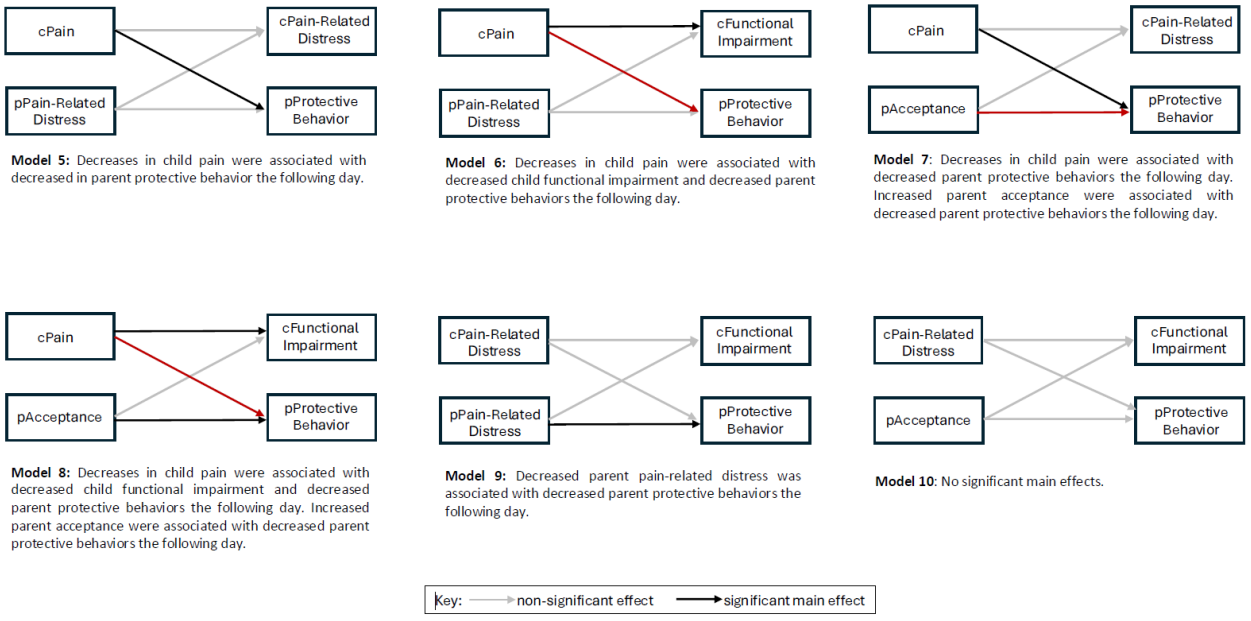


Figure 4: Temporal relationships between child and parent variables. *Note:* The red arrow indicates that the association between the variables was attenuated during the intervention compared to baseline.

Discussion

This study contributes to the growing body of research emphasizing the reciprocal relationship between child and parent functioning in pediatric chronic pain. The current study utilized data collected from youth-caregiver dyads who were participating in a multimodal intervention that integrated physical therapy and pain psychology targeted pain-related fear and avoidance and increased engagement in values-based goals and activities. The intervention also included three parent-only sessions targeting distress tolerance and willingness to have their child engage in activities despite the presence of pain. Leveraging daily assessments, we captured real-time associations between child pain intensity, pain-related distress, and functional impairment, highlighting key mechanisms through which parent responses—specifically parent distress and acceptance—may shape outcomes in youth. Most constructs in the daily assessments demonstrated meaningful within-person variability, supporting use of intensive longitudinal methods to examine real-time parent-child pain dynamics. Parent pain acceptance demonstrated lower within-person variability, suggesting that, day to day, parent pain acceptance did not fluctuate significantly.

Our results indicate that child pain intensity was significantly associated with same-day child pain-related distress and predicted higher functional impairment in youth and increased parent protective behaviors the following day. However, child pain intensity did not significantly predict next-day child pain-related distress or parent pain acceptance. Rather, child pain-related distress played a more central role, as it was strongly associated with both same-day functional impairment and parent protective behaviors, suggesting that pain-related distress may be a strong driver of maladaptive interactions. Consistent with prior research [27] these findings

reinforce the importance of targeting pain-related distress rather than focusing solely on pain reduction.

We also found that parent pain-related distress significantly influenced both child pain-related distress and functional impairment, reinforcing the bidirectional nature of these effects[1; 2; 15]. When parents reported lower pain-related distress, they reported engaging in fewer protective behaviors, and their child reported less pain-related distress and functional impairment. Given the strong influence of parental psychological and behavioral factors, it is critical that pediatric pain interventions include structured, parent-focused components. Current clinical recommendations suggest that parents should receive education on pain mechanisms and cognitive-behavioral strategies their child is learning to manage chronic pain, along with behavioral parent management training to reduce protective behaviors and reinforce functional improvement[18]. However, in real-world clinical settings, the implementation of parent interventions is inconsistent, and the optimal frequency and duration of these interventions remain unclear.

Our findings extend the current literature by identifying parent pain acceptance as a protective factor that predicts reductions in both child pain-related distress and parent protective behaviors. Specifically, we found that reductions in child and parent pain-related distress were associated with increased parent pain acceptance, which in turn was associated with lower child functional impairment and fewer parent protective behaviors. This relationship was also moderated by treatment phase, meaning that parents reported greater pain acceptance and decreased protective behaviors as they moved through the intervention. While not explicitly framed as an acceptance and commitment therapy (ACT) protocol, the treatment sessions that

parents in this study received focused on distress tolerance, engagement in values-based goals, and supporting their child's functional restoration—principles aligned with ACT. While parent pain acceptance showed relatively lower day-to-day variability, our findings indicate that it is modifiable in the context of treatment. This pattern suggests that although parent pain acceptance may not shift rapidly in response to daily fluctuations, it can change meaningfully over time when targeted through sustained and structured intervention.

These findings suggest that parent-focused interventions should move beyond behavior modification alone and incorporate strategies that enhance pain acceptance. Interventions that target both youth and parent pain-related distress concurrently, such as dyadic ACT models, may offer a more comprehensive approach.

Limitations and Future Directions

It is important to consider the following limitations when interpreting these findings. First, data were collected from only one parent, the majority of which were mothers. Given that family dynamics and caregiving roles may differ within households, future research should explore how other caregivers influence child pain outcomes. Additionally, youth in our sample were predominantly White and assigned female at birth. As a result, our findings are most representative of mother-daughter dyads, and generalizability to other parent-child combinations may be limited. While similar to demographics reported in other studies conducted in tertiary-level pain clinics[3], more diverse and representative samples are needed to fully understand how sociocultural factors and parent pain experiences shape these interactions, ensuring that interventions are accessible and effective for all families managing pediatric chronic pain. Another limitation is that almost half (45.6%) of parents reported currently experiencing

chronic pain (57.4% report history of chronic pain), which was not able to be controlled for in the current analyses. Prior research suggests that parents with chronic pain may experience heightened distress and altered pain-related behaviors, potentially influencing their responses to their child's pain[24]. Future studies should examine how parental pain history impacts dyadic pain-related interactions and treatment outcomes. Additionally, all daily diary constructs were assessed using items (2-3 items) from validated, full-length measures (e.g., ARCS, Parent Fear of Pain Questionnaire). While this approach allowed for repeated daily assessment with minimal participant burden, it may have limited the scope and sensitivity of construct measurement. For example, our measure of protective behavior includes only two items from the ARCS, which may not reflect the full range of maladaptive parenting behaviors relative to pediatric pain. As such, associations with outcomes may be conservative estimates of true estimates. Finally, while this study used daily assessments to capture real-time parent-child interactions, future research should explore longer-term trajectories of parent and child functioning beyond the treatment. Identifying whether increases in pain acceptance and reductions in pain-related distress and impairment persist over time is critical for developing sustainable, evidence-based interventions.

Conclusions

In conclusion, findings from this study reinforce the critical role of parental psychological factors in pediatric chronic pain treatment, particularly in relation to pain-related distress and pain acceptance. While existing interventions include parent-focused components, they primarily target behavioral modifications without directly addressing parental emotional responses. Our results suggest that enhancing parental pain acceptance should be a key treatment goal, as it may have downstream benefits on both parent and child functioning. Future research should

prioritize developing and testing interventions that explicitly incorporate parent-targeted acceptance-based strategies, either as standalone treatments or integrated into multimodal interventions. By expanding beyond behavior change to include acceptance and psychological flexibility, interventions may more effectively break cycles of distress, fostering long-term well-being for youth with chronic pain and their families.

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