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Social learning pathways in the relation between parental chronic pain and daily pain severity and functional impairment in adolescents with functional abdominal pain

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Introduction

For pediatric patients with functional abdominal pain (FAP), parental chronic pain (CP) is associated with long-term risk for increased pain severity and functional disability [36]. The intergenerational transmission of CP risk could be explained by multiple pathways including genetics [13; 34], early neurobiological changes resulting from maternal stress and medication use during prenatal and perinatal periods [1; 11], pain-specific social learning [22], general parenting and health behaviors [49], and shared environmental stress [25; 43]. These factors likely contribute to children's individual vulnerabilities that increase or decrease risk for CP in offspring of parents with CP (for a comprehensive review of plausible mechanisms see [41]).

The present study focused on pain-specific social learning as a factor contributing to intergenerational CP transmission. Social learning theory (SLT; [3]) suggests that individuals can learn behaviors through the observation of behaviors modeled by others and operant reinforcement of their own behaviors. In the pediatric pain literature, these two SLT processes typically have been examined independently. For example, laboratory studies of observational learning have manipulated parental modeling of pain behaviors [4; 7], and studies of operant reinforcement have manipulated parental responses to children's pain [47].

Studies evaluating SLT in pediatric CP rarely address a key component of SLT — cognitive processes. Indeed, a central factor that differentiates SLT from earlier Skinnerian behavioral models of learning is the inclusion of cognition as a mediating process. Instead of focusing solely on learning through the observation of a stimulus and response, SLT proposes two

cognitive components necessary for observational learning to occur: (a) attention to the modeled behavior and (b) cognitive encoding of the modeled behavior [3].

To address these gaps in the literature, the present study tested a comprehensive model of SLT pathways (Figure 1) as contributors to the relation between parental CP and adolescent's CP severity and functional impairment in adolescents with FAP and their parents. This model incorporated three novel elements into the evaluation of SLT in pediatric CP: (1) testing both parental modeling and parental reinforcement pathways in the same model, (2) incorporating adolescents' awareness of their parents' pain behaviors, and (3) including adolescents' encoding of learned pain behaviors into cognitive pain threat appraisals as a proximal outcome. We hypothesized that over the 7-day diary period, adolescents observing frequent negative pain behaviors (e.g., grimacing, avoiding activities) modeled by their parent would learn to appraise pain as more threatening, thereby influencing adolescents themselves to report more severe CP and pain-related impairment. Similarly, youth whose parents reinforced pain behaviors more (i.e., solicitousness) would appraise pain as more threatening (via attentional processes) and report more severe CP and impairment. Because adolescents' observations of parent pain behaviors could be influenced by their own experiences with pain, thereby introducing reporter bias, as an exploratory aim, we evaluated the two models using parents' self-reported pain behaviors to examine whether adolescents' observations of parental modeling were congruent with parents' self-reported pain behaviors.

Methods

Participants

The present study utilized a subset of baseline data collected as part of an ongoing IRB-approved, randomized controlled trial (RCT) evaluating the effect of an 8-week online cognitive behavioral therapy program on health outcomes in adolescents (ages 11 – 17 years) with FAP. Four hundred caregivers of pediatric patients were contacted via telephone prior to their child's initial medical appointment for abdominal pain at a tertiary gastroenterology clinic to describe the study, screen for eligibility, and invite participation at the time of their clinic visit. Inclusion criteria for pediatric patients were: (1) recurrent abdominal pain for at least the past two months in accordance with the ROME IV criteria for pediatric pain-related functional gastrointestinal disorders [18], (2) could read and write in English at the sixth grade level, and (3) easy access to a computer for completion of the pain diary. Exclusion criteria for pediatric patients were: (1) presence of a chronic disease (e.g., inflammatory bowel disease, diabetes), or (2) hospitalization within the month prior to study enrollment. Inclusion criteria for caregivers were: (1) could read and write in English at the sixth-grade level, and (2) had easy access to a computer. The presence of chronic pain in caregivers was not required to participate in the present study.

Of the 400 caregivers contacted via telephone, 120 dyads (30%) did not meet eligibility criteria, and 120 dyads (30%) declined participation. There were no differences between dyads who enrolled versus those who declined on demographic variables (e.g., age, gender). We enrolled 160 dyads who met eligibility requirements for participation in the study at their initial clinic visit for abdominal pain. If either the parent or child did not complete the

baseline survey, the dyad was excluded from analyses ($n = 3$). In addition, based on an examination of medical records from the clinic evaluation, two dyads were excluded after enrollment because the youth was diagnosed with inflammatory bowel disease and one child was excluded after enrollment due to developmental delay. Thus, the final sample included 154 dyads (adolescent age: $M = 14.14$, $SD = 1.87$; adolescent sex: 66.9% female; participating parent: 90.9% mothers).

Procedures

A member of our research staff approached patients and parents who agreed to hear more about our study in the clinic. Informed consent was obtained from parents and informed assent was obtained from adolescents. Both adolescents and their parents completed a baseline survey during their clinic visit on REDCap, a secure online survey site [17]. Adolescents were informed that they would be asked questions about pain, mood, sleep, and activities. Research staff did not provide any additional rationale for asking about parent pain beyond the instructions included with the measures. Adolescents and parents completed similar surveys independently and neither was allowed to see the others' answers. Following the initial clinic visit, adolescents completed an online diary that assessed pain and functional impairment once per day for 7 days. This diary assessment took place before any formal intervention was initiated.

Baseline Measures

Parent pain behaviors—Parent pain behaviors were assessed with the PROMIS Pain Behavior – Short Form (PPB; parent self-report) and the Parent Pain Behavior-Proxy (PPB-Proxy; adolescent proxy-report) [2; 39]. The PROMIS Pain Behavior-Short Form was developed as a part of the National Institute of Health Patient-Reported Outcomes Measurement Instrument System (PROMIS) [33]. An expert committee developed a pain behavior item bank based on existing observer-rated and self-reported pain behavior instruments, expert opinion, and qualitative interviews with CP patients. The item bank was then evaluated with item response theory and items with the best psychometric properties were chosen for inclusion in the short form [2]. An adolescent proxy-report version of the PROMIS Pain Behavior-Short Form (PPB-Proxy) was developed by our team to measure adolescents' reports of parent pain behaviors. In a preliminary measure validation study utilizing a portion of the present sample, the PPB-Proxy exhibited good internal consistency, moderate agreement with parent self-report, and adequate convergent and discriminant validity [39]

Both the PPB and PPB-Proxy comprised 7 items that captured observable pain behaviors over the past 7 days (e.g., “moved extremely slowly”). Due to the item wording and short time frame (i.e., one week) for retrospective report, parent pain behaviors were relevant for parents both with and without chronic pain. For example, a parent could have experienced a number of acute painful experiences (e.g., muscle cramps from exercising; an occasional sinus headache) which could have precipitated pain behaviors in the absence of the parent meeting criteria for chronic pain. Both measures contain the same items, except that the PPB utilized the stem, “When I was in pain, I...,” whereas the PPB-Proxy utilized the stems, “When my mother was in pain, she...” or if applicable, “When my father was in pain, he...”

Response options ranged from (1) “Had No Pain” to (6) “Always.” A total raw score was computed and ranged from 7 to 42. Separate totals were computed for the parent self-report and adolescents’ proxy reports of the parent’s pain behavior. For data analyses, we used either the mother or father report depending on which parent participated in the study so that adolescents and parents reported on the same individual. Alpha reliabilities in the current study for the PPB and PPB-Proxy were .93 and .95, respectively.

Parental responses to adolescents’ pain—A parent-report short-form version of the Adult Responses to Children’s Symptoms (ARCS-SF-A) assessed parental solicitous and protective responses to children’s pain. The ARCS-SF-A contains 10 items from the Solicitousness, Protect, and Distract subscales determined to be well suited for parents of adolescents based on a developmental analysis of the factor structure of the ARCS [28]. The ARCS-SF-A contains all three items from the Solicitousness subscale (“Do your child’s chores or pick up your child’s things instead of making him/her do it,” “Bring your child special treats or little gifts,” and “Give your child special privileges”), and all three items from the Distract subscale (“Talk to your child about something else to take your child’s mind off of it,” “Encourage your child to do something he or she enjoys,” and “Try to involve your child in some activity”). The Protect subscale contains 4 items selected based on high factor loadings and conceptual coherence (“Let your child stay home from school,” “Stay home from work or come home early,” “Tell others in the family not to bother your child,” and “Let your child sleep later than usual in the morning”). The measure utilizes the stem, “When your child has a stomachache or abdominal pain, how often do you...” Item responses range from (0) “Never” to (4) “Always,” and responses to items for each subscale are summed to yield a total score. Alpha reliabilities for the Solicitous and Protect subscales were 0.61 and 0.72, respectively, which are similar to alpha reliabilities reported previously in parents of adolescents with chronic pain [28].

Parental chronic pain—The Persistent Pain Questionnaire (PPQ) assessed parental CP [5; 6; 36; 39]. The primary participating parent identified locations of current CP based on eight standard body locations described by the International Association for the Study of Pain [26]: head, neck, shoulder/arm/hand, chest, abdomen, pelvic area, upper or lower back, and legs/feet. For each site, parents were asked if they had experienced pain daily or almost daily for the past 3 months. If they responded positively to this question, they were asked to rate their current pain severity at that site on a scale of 0–100. Parents were considered to have current CP at a body location if they rated the pain at that site at greater than or equal to 30, representing moderate or greater pain intensity [46]. For descriptive purposes, the number of locations for which parents reported current pain severity ≥ 30 out of 100 were summed to indicate the number of current parental chronic pain locations. Parental chronic pain status (yes/no), indicated by at least one current parental chronic pain location, was utilized as the primary indicator of parental chronic pain in analyses.

Adolescent pain threat appraisal—The Pain Beliefs Questionnaire-Short Form (PBQ-SF) assessed adolescents’ pain threat appraisals [40]. The PBQ-SF is an 18-item questionnaire that includes a six-item Pain Threat scale, which measures the extent to which patients view their pain as a serious threat to their well-being (e.g., “My stomach aches mean

I have a serious illness”). Pediatric patients rated how true each item was for them regarding their stomach aches on a 0 (“not at all true”) to 4 (“very true”) scale. Items from the scale are summed to yield a total score with higher scores indicating stronger beliefs that pain represents a significant threat. Alpha reliability in the current study for the Pain Threat scale was 0.78. The Pain Threat measure was used here to assess the cognitive component of SLT, and was included to explore whether observed parental pain behaviors were related to adolescents’ pain and functional impairment levels.

Adolescent Daily Diary Measures

An online, secure, 7-day diary assessed adolescents’ daily pain and functional impairment following their initial clinic visit. Maximum likelihood estimation was utilized to treat missing diary data in the path analyses. Only 4.5% of adolescents ($n = 7$) had missing diary data for at least one of the seven days.

Average daily pain severity—Each day, adolescents reported on their pain severity using an 11-point rating scale (0 = no pain and 10 = worst pain). Higher scores indicate greater pain severity. Daily diary pain ratings were averaged across the seven days to yield a mean pain severity score (alpha reliability = 0.83).

Average daily functional impairment—Items from the Child Activity Limitations Interview (CALI) were administered daily during the diary period to assess adolescent’s functional impairment due to pain [30; 32]. The CALI was administered to pediatric patients during the initial clinic visit by a trained research assistant who helped each patient select 8 activities from a list of 21 possible activities for the youth’s daily diary. Activities were selected based on youth’s ratings of activity difficulty and importance. These same 8 activities were used for completing the daily diary throughout the 7-day assessment period. Patients provided daily difficulty ratings for each activity on a 5-point scale ranging from 0 (no difficulty) to 4 (extremely difficult). Daily difficulty ratings were averaged across the seven days to yield a functional limitation mean score (alpha reliability = 0.88). Other studies have administered the CALI in a daily diary format with adolescents with chronic pain [21; 31].

Data Analyses

Descriptive analyses were conducted with IBM SPSS Statistics for Windows, Version 24.0 [19]. Path analyses were conducted with MPlus7 [27] to examine multiple mediation pathways accounting for the relation between parental CP status reported at the baseline clinic visit and adolescents’ daily pain and functional impairment over the subsequent 7-day diary period. Path analysis specifies a structural model based on a priori theorized relations between variables and utilizes a series of multiple regressions to statistically model specified paths. Although path analysis implies the presence of causal influence, directionality cannot be established in cross-sectional data analyses as were conducted in the current study, because the causal influence could be in the opposite direction, or due to the operation of additional, third variable unmeasured factors. Thus, the present study utilized path analysis to prospectively test the degree to which the data were consistent with the proposed

theoretical model but cannot make any firm conclusions regarding directionality or timing of effects.

We utilized a bootstrap estimation approach with 5000 samples to examine both overall model fit and hypothesized indirect pathways. This approach utilized maximum likelihood estimation to handle missing data points. Two different models were tested to examine path effects for two primary distal outcomes (the key clinical outcomes of interest): (1) pain severity averaged over the 7-day diary period, and (2) functional impairment averaged over the 7-day diary period. The adolescent's pain threat appraisal was the proximal outcome (intrapyschic) hypothesized to predict the distal clinical outcomes in both models. Youths' observations of parent pain behaviors and parents' self-reported solicitous responses to adolescents' pain were entered as the possible mediators.

Adapting syntax from Thoemmes, MacKinnon, and Reiser [42], we conducted a power analysis in Mplus 7 using a Monte Carlo simulation which drew 10,000 samples of 150 observations. The independent variable, parental chronic pain, was dichotomous, whereas the dependent variables were all continuous. Path coefficients were set according to moderate effect sizes. With a sample size of 150 participants, the models tested could be estimated with at least 80% power for all direct and indirect pathways.

The present study specifically focused on two hypothesized indirect pathways within each of the two models (see Figure 1). The first pathway tested was one in which presence of parental CP predicted more frequent adolescent-reported parent pain behavior, which predicted greater adolescent pain threat appraisal (proximal outcome) and more severe adolescent pain outcomes over the one-week diary period (model 1 distal outcome: greater adolescent average daily pain severity; model 2 distal outcome: greater adolescent average daily functional impairment). The second pathway tested was one in which presence of parental CP predicted more frequent parent-reported solicitous responses to adolescent pain, which predicted greater adolescent pain threat appraisal and more severe adolescent pain outcomes over the one week diary period (model 1 distal outcome: greater adolescent average daily pain severity; model 2 distal outcome: greater adolescent average daily functional impairment).

Results

Demographics and Preliminary Analyses

Participant demographics are summarized in Table 1. On average, adolescents were 14-years-old and predominately female. The majority of parents were mothers and three-quarters of the parents reported at least one CP site (see Table 2 for parent pain characteristics). On average, parents reported 2 CP locations. Adolescents of parents with CP, compared to adolescents without a parent with CP, were more likely to observe parental pain behaviors ($t[148] = -4.38, p < 0.001$, Cohen's $d = 0.90$). Parents with CP compared to parents without CP were more likely to report solicitous responses to adolescent pain ($t[151] = -2.33, p = 0.02$, Cohen's $d = 0.45$), but not protective responses ($t[152] = -0.74, p = 0.46$, Cohen's $d = 0.14$). Given this pattern of findings, path analyses focused solely on parents' solicitous responses to adolescent pain.

Path Analyses

Figure 2 presents the statistical model for adolescents' average daily pain severity, and Figure 3 presents the statistical model for adolescents' average daily functional impairment. In both models, positive parental CP status was significantly associated with more frequent adolescent-reported parental pain behaviors at baseline ($b = 7.05$, $SE = 1.44$, $p < .001$) and with more frequent parent-reported baseline solicitous responses to adolescents' pain ($b = 0.35$, $SE = 0.15$, $p = 0.02$). More frequent adolescent-reported parental pain behaviors at baseline, in turn, were significantly associated with more severe adolescent baseline pain threat appraisals ($b = 0.03$, $SE = 0.01$, $p < .01$). Consistent with the proposed model, more severe adolescent baseline pain threat appraisals significantly predicted adolescents' subsequent daily pain severity over the 7-day diary period ($b = 1.0$, $SE = 0.18$, $p < .001$). The indirect pathway from parental CP status through adolescents' report of parent pain behaviors and adolescent pain threat appraisals was significant for both adolescent daily pain severity ($b = 0.18$, $SE = 0.08$, 95% CI: 0.04, 0.31, $p = 0.03$) and adolescent daily functional impairment ($b = 0.08$, $SE = 0.04$, 95% CI: 0.02, 0.15, $p = 0.03$). Although parents with chronic pain were more likely to report solicitous responses, the indirect pathway through parental solicitousness did not reach significance for either adolescent pain severity or adolescent functional impairment. Overall model fit indices indicated a good fit for both models (pain severity: RMSEA = 0.00, 90% CI for RMSEA = 0.01, 0.15, $\chi^2 = 0.13$, $p = 0.72$, CFI = 1.00; functional impairment: RMSEA = 0.00, 90% CI for RMSEA = 0.01, 0.15, $\chi^2 = 0.10$, $p = 0.76$, CFI = 1.00).

To address potential confounds, analyses were repeated regressing adolescent age and sex as control variables on adolescents' reports of parent pain behaviors, parent solicitousness, adolescent pain threat appraisals, and dependent variables (adolescent functional impairment, adolescent pain severity). The inclusion of these control variables did not change the path analysis findings regarding direct and indirect effects. To maximize clarity, these control variables are not included in the theoretical models presented graphically.

Finally, In exploratory analyses, parents' self-reported pain behavior was substituted into the models in place of adolescents' report of parent pain behavior. This was done to evaluate the extent to which adolescents' reports accurately reflected parents' self-reported pain behaviors. The same pattern of results was found for parents' self-reported pain behaviors; that is, consistent with the proposed model, the indirect pathway from parental CP status through parents' self-reported pain behaviors and adolescent pain threat appraisal was significant for both adolescent pain severity ($b = 0.27$, $SE = 0.12$, 95% CI: 0.07, 0.46, $p = 0.02$) and adolescent functional impairment ($b = 0.13$, $SE = 0.06$, 95% CI: 0.04, 0.22, $p = 0.02$). The indirect pathway through parental solicitousness remained non-significant for both outcomes. Overall, fit indices remained adequate for both models (pain severity: RMSEA = 0.14, 90% CI for RMSEA = 0.01, 0.29, $\chi^2 = 3.95$, $p = 0.05$, CFI = 0.97; functional impairment: RMSEA = 0.14, 90% CI for RMSEA = 0.05, 0.29, $\chi^2 = 3.95$, $p = 0.05$, CFI = 0.97).

Discussion

This is the first study of adolescent patients with functional abdominal pain to simultaneously evaluate adolescents' observations of parental pain behavior and parental reinforcement as prospective predictors of adolescents' daily pain severity and functional impairment. The findings make four important contributions to our understanding of social learning in pediatric chronic pain. First, parental pain behaviors (i.e., modeling) had the strongest relation to adolescents' subsequent daily pain severity and functional impairment in the context of parental chronic pain. Second, adolescents were aware of parent pain behaviors, as indicated by the correspondence in path analysis outcomes between parent self-report or adolescent proxy-report of parental pain behaviors. Third, parental pain behaviors provide important information beyond parental chronic pain status. Having a parent with chronic pain may increase risk for pain and related outcomes in youth, but measuring and understanding mechanisms such as parental modeling that may drive this relation provides specific targets for intervention. Fourth, data analyses from the present study were consistent with the theoretical model that incorporated adolescents' cognitive appraisal of pain threat as a proximal social learning pathway predicting the clinical outcomes of distal pain and impairment, addressing an important aspect of Bandura's SLT that often has been overlooked in pediatric pain research.

Presence of parental pain behaviors (i.e., modeling), in contrast to parental reinforcement of adolescents' pain behaviors (i.e., solicitousness), had a stronger relation to adolescents' pain severity and impairment in the context of parental chronic pain. Although parents with CP were more likely to report solicitous responses to adolescents' pain, such solicitousness was not significantly related to adolescents' pain threat appraisals, pain severity, or functional impairment in the test of the SLT model that included parent modeling of pain behaviors. Although parents' protective and solicitous responses to children's pain consistently have been found to be associated with increased pain and functional impairment [8–10; 16; 37; 45; 48], these factors may be driving increased pain and functional impairment in adolescents independently of the relation between parent and child CP. This is consistent with Levy and colleagues' [24] finding that the relations of parental IBS status (serving as a proxy measure of parental modeling) and parental solicitousness to children's gastrointestinal symptoms were distinct. Alternatively, weaker effects in analyses for the path via parental solicitous responses may have been due in part to measurement issues with this construct (e.g., modest alpha reliability). Despite this possible limitation, the present study is unique in attempting to directly examine the differential relation of these two pathways in a clinical sample of youth with FAP, specifically measuring parents' pain behaviors in addition to CP status, and incorporating adolescents' cognitive appraisals in the model.

The results of our SLT model tested here suggest that adolescents' interpretations and appraisals of pain may account, in part, for the relation between parents' and adolescents' pain behaviors. Both adolescents' observations of parents' pain behavior and parents' self-reported pain behavior exhibited significant relations with adolescents' pain severity and functional impairment via adolescents' pain threat appraisals. The incorporation of adolescents' pain appraisals into the evaluation of observational learning of parent pain

behavior is novel, and in line with Bandura's SLT [3] and social learning models of fear acquisition [29].

Prior pediatric pain research has inferred observational learning of pain behavior based on the high rate of chronic pain within families or clustering of health care seeking behaviors for pain within families [20; 24; 35; 44] without specifically addressing children's attention to and encoding of specific parental pain behaviors. The present study advances the literature in that it incorporated adolescents' encoding of parents' modeled behaviors by assessing their observations of parents' pain behaviors and the links of these observed behaviors to adolescents' appraisal of pain threat. The indirect pathway between parent pain behavior and adolescents' daily pain severity and daily functional impairment via adolescent pain threat appraisal remained significant regardless of whether parent pain behavior was reported by adolescents or parents. The use of questionnaires as proxy measures for adolescents' attention to parental modeling and cognitive encoding of behaviors is a limitation of the present study, however. Future research utilizing more direct, observational measures (e.g., eye tracking to measure adolescents' attention to parents' behaviors while parents complete a task which may induce pain) could provide important information regarding the cognitive processes during learning.

The current study had several strengths including the clinical sample of youth with FAP, measurement of both parent-reported pain behaviors and adolescents' proxy-report of parental pain behaviors, use of daily diaries to measure adolescent outcomes, and utilizing a theoretical framework to guide the formulation of the tested model. The social learning pathways tested in this model were theoretically driven and mapped onto the proposed integrative conceptual model for the transmission of risk for CP from parents to offspring [41]. Indeed, this model tested parental CP as a major risk factor operating through two plausible social learning mechanisms (parental modeling, parental reinforcement), which may contribute to adolescents' vulnerabilities (e.g., pain threat appraisals) that then predict adolescents' outcomes (pain severity, disability).

Limitations regarding the interpretability and generalization of these findings, however, also should be noted. A high proportion of parents in the present study (76.6%) reported CP within the past three months, which could have limited variability within the tested model. Second, parents in the study were predominantly mothers and thus findings may be specific to maternal CP. Third, the present study focused on social learning mechanisms as possible explanations for the relation between parent and child pain, but this relation is likely a complex representation of multiple biological and psychological factors. Genes could account for up to 50% of the variance in CP [12]. Thus, the possible effects of some third variable (e.g., genes) on the observed relation between parents' and children's pain behaviors cannot be ruled out. To address these limitations, future research incorporating biological factors (e.g., genetics, stress response systems) and potential moderators (e.g., pain in second parent, timing and course of parental chronic pain, parent and child resilience factors) are needed to better evaluate the complex, multifactorial nature of the intergenerational transmission of risk for chronic pain.

Aside from the prospective diary assessment of adolescent pain severity and functional impairment, the majority of the measures in this study were collected at the same time point. Thus, directionality and temporality among the study variables cannot be determined here. Although observational learning of pain behaviors likely emerges throughout development, this study represents a snapshot of processes that might have been in effect for years prior to adolescents' development of CP. Finally, it is also possible that adolescents' CP behaviors affect parents' pain behaviors.

To further test the proposed model that adolescents' pain appraisals at least partially account for the relation between parental pain behaviors and adolescents' pain and functional impairment, both intervention studies and longitudinal, translational studies are needed to determine the timing of effects. For example, intervention studies targeted at reducing adolescent pain threat appraisals could explore whether reductions in adolescents' pain threat decouples the relation between parental pain behaviors and adolescent pain and functional impairment. Longitudinal studies also are needed to both determine temporal relations and test dyadic interactions between parents' and children's pain and pain behaviors.

A number of cognitive behavioral therapy trials for pediatric chronic pain have resulted in moderate reductions in adolescent pain and functional impairment [15]. However, the effects of these interventions rarely continue to show improvement at follow-up intervals between three and twelve months post-intervention [14]. Although social learning theory has guided the development of a few interventions that include components targeting parental modeling and parental solicitousness [23; 31], these interventions have not explicitly measured parental modeling of pain behavior. Given that parental modeling and parental solicitousness may be related to children's symptoms differently [24], measuring both will be essential for determining the efficacy of interventions on such social learning mechanisms. Children who improve in their pain and functional impairment through individual psychotherapy, but have parents who continue to experience CP and model frequent maladaptive pain behaviors may have more difficulty responding to treatment and maintaining treatment gains. Perhaps this could be due to continued modeling and signaling from parents that pain represents a significant threat demanding attention in the face of opposite messages conveyed during their individual psychotherapy sessions for CP. Interestingly, in treatment studies of youth psychopathology, higher levels of maternal depressive symptoms have been associated with poorer response to cognitive behavioral therapy in their children [38]; similarly, parental CP might impact the extent to which their children respond to treatment.

The ultimate goal of identifying mechanisms of the transmission of risk for CP and functional impairment from parents with CP to their children is to develop novel targets for treatment and prevention efforts. Identifying mechanisms underlying increased risk for CP and functional impairment in children of parents with CP ultimately could lead to interventions that could decrease healthcare costs and improve functioning and quality of life in families experiencing CP. Based on the present study, parental modeling of pain behaviors represents a promising target for family-based interventions to prevent or ameliorate pediatric CP.

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Figure 1.

Hypothesized model for social learning mechanisms accounting for the relation between parent and child chronic pain and daily pain severity

Note. Solid black lines represent pathways hypothesized as statistically significant. Dotted grey lines represent pathways included in hypothesized model, but not as part of primary hypotheses. The same model was hypothesized substituting adolescent average daily functional impairment for adolescent average daily pain severity as the distal outcome.

Figure 2.

Path analysis testing social learning theory mechanisms for the relation between parental chronic pain status and subsequent adolescent daily pain severity

Note. Each path labeled with coefficient estimate (standard error). Black solid lines indicate significant direct paths ($p < .05$). Grey dotted lines indicate non-significant paths ($p > .05$).

Error variances are as follows: $e_{\text{painbeh}} = 68.04 (6.01)$, $e_{\text{solicit}} = 0.62 (0.06)$, $e_{\text{painthreat}} = 0.69 (0.07)$, $e_{\text{painseverity}} = 2.82 (0.31)$.

Figure 3.

Path analysis testing social learning theory mechanisms for the relation between parental chronic pain status and subsequent adolescent daily functional impairment

Note. Each path labeled with coefficient estimate (standard error). Black solid lines indicate significant direct paths ($p < .05$). Grey dotted lines indicate non-significant paths ($p > .05$). Error variances are as follows: $e_{\text{painbeh}} = 68.04 (6.01)$, $e_{\text{solicit}} = 0.62 (0.06)$, $e_{\text{painthreat}} = 0.69 (0.07)$, $e_{\text{impairment}} = 0.58 (0.06)$

Table 1

Participant demographic characteristics

Demographic Characteristic	FAP (n = 154)
Age, $M \pm SD$	14.14 $\pm$ 1.87
Sex, n (%)	
Female	103 (66.9)
Race, n (%)	
Caucasian	128 (83.1)
African-American	13 (8.4)
Other	13 (8.4)
Participating parent, n (%)	
Mother	140 (90.9)
Father	11 (7.1)
Grandmother	3 (1.9)
Parent highest level of education, n (%)	
High school or less	34 (22.1)
Vocational school/some college	55 (35.7)
Four year college	47 (30.5)
Graduate/professional school	18 (11.7)
Parent marital status, n (%)	
Married or partnered	105 (68.2)
Separated or divorced	30 (19.5)
Single	19 (12.3)

Table 2

Parent pain characteristics

Parent Pain Characteristics	n = 154
Parent reported at least one chronic pain location, <i>n</i> (%)	118 (76.6)
Number of parent chronic pain locations, <i>M</i> ± <i>SD</i>	2.44 ± 2.15
Parent chronic pain locations, <i>n</i> (%)	
Head	77 (50.0)
Upper or lower back	73 (47.4)
Leg, foot, knees, or ankles	51 (33.1)
Shoulder, arm, or hand	46 (29.9)
Abdomen	45 (29.2)
Neck	44 (28.6)
Pelvis	22 (14.3)
Chest	18 (11.7)
Highest average pain intensity reported at any one pain location (0–100), <i>M</i> ± <i>SD</i>	58.68 ± 32.48

Note: Numbers do not sum to 100% because parents could report more than one pain site.