

Parental catastrophizing about child's pain and selective attention to varying levels of facial pain expression in children: A dot-probe study

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ABSTRACT

The attentional demand of pain has been primarily investigated within an intrapersonal context. Very little is known about observers' attentional processing of another's pain. The present study investigated, within a sample of parents ($n = 65$; 51 mothers, 14 fathers) of school children, parental selective attention to children's facial pain display and the moderating role of child's facial pain expressiveness and parental catastrophizing about their child's pain. Parents performed a dot-probe task in which child facial pain displays (of varying pain expressiveness) were presented. Findings provided evidence of parental selective attention to child pain displays. Low facial pain displays appeared sufficiently but also, as compared to higher facial pain displays, equally capable of engaging parents' attention to the location of threat. Severity of facial pain displays had a non-spatial effect on attention; i.e. there was increased interference (i.e. delayed responding) with increasing facial expressiveness. This interference effect was particularly pronounced for high catastrophizing parents, suggesting that being faced with increasing child pain displays becomes particularly demanding for high catastrophizing parents. Finally, parents with higher levels of catastrophizing increasingly attended away from low painful faces, whereas selective attention to high painful expressions did not differ between high and low catastrophizing parents. Theoretical implications and further research directions are discussed.

1. INTRODUCTION

Pain captures attention of the sufferer in pain and prioritizes actions aimed at escaping or avoiding further harm [13;46]. Besides these intrapersonal functions, pain may also enhance interpersonal adaptation by warning others and by instigating a variety of caregiving responses in others [8;14;17;52]. This is particularly important in parent-child relationships. Children are dependent upon available care from others, particularly from their parents who carry the responsibility for their child [4;34]. In turn, parental responses may have a substantial impact upon their child's pain experience [34;49]. Central to interpersonal accounts of pain [14;20] is the idea that one's pain is also powerful in capturing the attention of others. Yet, the attentional demand of pain has been primarily investigated within an intrapersonal context [1;12;23;36;42;43;45;46]. Very little is known about observers' attentional processing of pain in others [24;55]. Systematic research into parental attentional processing of children's pain is lacking.

The extent to which the child's pain comes to the focus of attention in parents is likely to be modulated by a myriad of variables. Drawing upon the cognitive –affective model on the interruptive function of pain, particularly those variables that amplify the threat value of pain may enhance attention to pain [13;46]. One of the variables considered to be vital is the child's facial expression of pain. Facial expressions of pain are highly salient in signifying pain to others [9;40;41;52;53]. Based on studies on attentive processing of threat [54;56] it is conceivable that attention is allocated to salient pain expressions.

Not only features of the child in pain, but also individual differences in parents may affect attention to the child's pain and further modulate the effects of the child's pain expression [14;16]. Parental catastrophic thoughts about the child's pain, characterized by an exaggerated negative focus on their child's pain [15;39], are particularly likely to influence attention to the child's pain. Specifically, parental catastrophizing is associated with

heightened inferences of pain intensity of their child [3;16]. Furthermore, catastrophic representations about one's *own* pain have consistently been found to be related to increased attention to pain [42;43;45]. Accordingly, parental attention to the child's pain displays may be enhanced in those parents who catastrophize about their child's pain. However, because high pain displays are unlikely to go unnoticed for anyone [13;52], the effects of parental catastrophizing may be particularly pronounced for mild levels of child pain display [13;32;54].

In sum, the present study investigated parental attention to children's facial pain display and the moderating role of child's facial pain intensity and parental catastrophizing about their child's pain. Parents were requested to perform a pictorial dot-probe task, a well-investigated reaction time task designed to measure selective attention to the location of threat [see e.g. 1;12;26;27]. We expected that (1) parents would selectively attend to children's facial pain displays, (2) selective attention to pain faces would increase with higher levels of facial pain expression, and (3) individual differences in attention to facial pain displays would be associated with parental catastrophizing such that even mild levels of facial pain expression attracts more attention in high catastrophizing parents.

2. METHOD

2.1 Participants

The present study consisted of two parts. In a first part, parents performed the attentional dot-probe task, and in a subsequent part, the child performed a painful task (thermal heat stimuli). The present study only reports data from the first part of the study which aimed at investigating parents' selective attention to children's pain faces. Participants were recruited from a sample of school children from grades 6 to grades 9 and their parents (n= 403) who participated in a questionnaire study that took place approximately 2 years prior to the present study. Only children and parents who had provided informed consent to be re-

contacted and who had not already been invited for participation in another study were approached ($n = 280$). Children and their parents were eligible to participate if the child did not suffer from any chronic illness including recurrent or chronic pain, or a developmental disorder. Moreover the child and parent had to be able to speak and write Dutch. A weighted random sampling procedure was used [21] with an equal proportion of boys and girls and with an equal age distribution. From the total of 280 parent-child dyads who consented, 133 parent-child dyads were randomly selected and contacted. Of those contacted, 98.5% ($n=131$) met the inclusion criteria and 58.0% ($n=76$) of them agreed to participate. Main reason to refuse participation was lack of time due to work/family demands. Ten parent-child dyads later withdrew participation because of illness of their child or other family responsibilities and one parent did not perform the dot-probe task due to late arrival at the lab. The final sample included in the study consisted of 65 parents (51 mothers, 14 fathers) and their child (34 boys, 31 girls; Mean age = 13.0, $SD = 1.29$). Parents ranged in age from 35 to 55 years ($M = 44.2$ years, $SD= 4.7$). Most parents (87.7%) were married or co-habiting. The majority of the parents (73.8%) had higher education (beyond the age of 18 years). Participants were compensated 35€ for participating in this study. The study was approved by the Ethics Committee of the Faculty of Psychology and Educational Sciences of Ghent University, Belgium.

2.2 Measures

Parents completed a battery of questionnaires designed to assess socio-demographic characteristics, catastrophic thinking about their child's pain, and parents' level of trait anxiety.

2.2.1 Pain catastrophizing

Parental catastrophic thinking about their child's pain was assessed with the Dutch version of the Pain Catastrophizing Scale for Parents (PCS-P) [15]. This instrument is an

adaptation of the adult Pain Catastrophizing Scale (PCS) [39] and the Pain Catastrophizing Scale for Children (PCS-C) [10]. The PCS-P consists of 13 items describing different thoughts and feelings that parents may experience when their child is in pain. Parents rate how frequently they experience each of the thoughts and feelings when their child is in pain using a 5-point scale (0 = 'not at all', 4 = 'extremely'). The PCS-P consists of three subscales (1) rumination (e.g., '... I keep thinking about how much it hurts'), (2) magnification (e.g., '... I wonder whether something serious might happen') and (3) helplessness (e.g., '... there is nothing I can do to reduce the pain') and yields a total score that can range from 0 to 52. The PCS-P has been shown to be reliable and valid [15]. Cronbach's alpha in this study was $\alpha=.88$.

2.2.2 Trait anxiety

The trait version of the *State-Trait Anxiety Inventory* [STAI-T;38;47] was administered to measure parents' anxious disposition to interpret situations in a threatening way. Previous findings have indicated high trait anxious persons selectively attend to threatening information [see e.g. 25;26]. Including the STAI-T within analyses enabled to explore the conceptual utility and unique value of parental catastrophizing about the child's pain in understanding parental attentional processing of child pain displays. The STAI-T consists of 20-items (e.g., 'I feel afraid'). Participants are asked to use a 4-point scale to indicate how often each item/statement is true for them (1 = 'seldom/never' to 4 = 'very often/always'). Total scores range from 20 to 100. The STAI has been shown to be a reliable and valid instrument [38;47]. Cronbach's alpha in this study was $\alpha=.93$.

2.3. Materials and apparatus

2.3.1 Pictorial Stimuli

Stimulus material for the dot-probe task consisted of 40 pictures of children displaying painful faces. All pictures were selected from videotapes drawn from an existing pool of

school children who had taken part in previous studies using the cold pressor task [see e.g. 48], and who had previously provided informed consent for using/showing the videos for research purposes. Each videotape was previously coded (per second) by means of the Child Facial Coding System. The CFCS [5] provides a fine-grained coding of 13 distinct facial actions (e.g. ‘brow lowerer’, ‘eye squeeze’, ‘lip corner puller’) and ranges from 0 to a maximum of 23 for each second being coded¹. For the present study, 10 videotapes (5 boys and 5 girls; age range 9-16 years) with high variation in facial expression of pain were selected. This enabled us to select 4 different pictures from each child; one depicting a neutral face (Facial Expression (FE) = 0), one with low pain expression (FE range 2-4), one with moderate pain expression (FE range 5-7) and one with high pain expression (FE range 8-12). Using these 40 pictures, a series of three different pairs were generated and matched upon head position, colour intensity and luminance. Each pair consisted of two pictures of the same child presenting a neutral face combined with either (1) a low expressive pain face (NFE-LFE); (2) a moderate expressive pain face (NFE-MFE); or (3) a high expressive pain face (NFE-HFE). Furthermore, 8 non-painful pictures from 2 other children were selected for the practice trials.

Twelve independent judges (6 mothers, 6 fathers, age range 33-66 years) rated the 40 pictures on pain intensity using a 0-10 numerical rating scale (NRS). These twelve judges consisted of a different group of parents than those who participated in the present study. Picture ratings were analyzed using Analysis of Variance (ANOVA) in order to validate whether the selection of pictures with different facial pain expressiveness resembled differences in pain intensity categories. Analysis indicated significant differences in picture ratings between different sets ($F(3,9) = 69.44, p < .0001$). Further contrast analyses revealed that pain ratings of high expressive pain faces ($M=6.96, SD=2.26$) were significantly higher

¹ The maximum FE for a still image is slightly lower (20) given that facial actions occurring at the eyes can occur sequentially within the same second but not simultaneously (e.g. squint (eyes open), eye squeeze/blink (eyes closed)).

than ratings of moderate expressive pain faces ($M=5.17$ $SD=2.67$; $F(1,11) = 89.30$, $p<.0001$). Moderate expressive pain faces were rated significantly higher in pain intensity than low expressive pain faces ($M=3.53$ $SD=2.58$; $F(1, 11) = 53.12$, $p<.0001$) and low expressive pain faces were rated significantly higher in pain intensity than neutral faces ($M=2.07$ $SD=2.12$; $F(1, 11) = 42.93$, $p<.0001$).

2.4 Dot-probe task

Participants were seated in front of a computer at a distance of approximately 60 cm from the screen. Instructions for the dot-probe task were presented on the computer screen and explained. To enhance parent involvement with the task, they were also informed that they would see several pictures of children who have undergone the same painful procedure (i.e. thermal heat stimuli) as their child would undergo in the second part of the current study.

All pictorial stimuli were presented against a black colored background. Each trial in the dot-probe task began with a 500 ms presentation of a white fixation cross in the middle of the screen. Participants were instructed to fixate their gaze on this location. Then, one picture-pair (NFE-LFE; NFE-MFE; NFE-HFE) appeared that remained visible for 500ms; each facial image in this pair was 47 mm in width and 78 mm in height; one of the pictures was presented above and one below the fixation cross with the centre of the picture having a distance of 57 mm above and below the centre of the screen. Immediately after the offset of the two pictures, a small white rectangle (.9/1 mm; dot-probe) was presented, replacing one of the pictures. Participants had to indicate the probe location by pressing one of two buttons as quickly and accurately as possible on an AZERTY keyboard²: the ‘q’ key with the left index finger when the probe was presented at the upper location and the ‘m’ key with the right index finger when the probe was presented at the lower location. A new trial started after a response or automatically when 2500 ms elapsed without response. When responded erroneously, the

² The AZERTY keyboard layout is a specific layout used most often in (partly) French-speaking nations, particularly across Europe.

term ‘error’ briefly (200 ms) appeared on the screen. Pictures were presented in randomized order across trials and participants. The target (pain face) pictures as well as the probe were presented equally often at the top or bottom position of the screen and the dot-probe was equally likely to replace either a pain face or neutral face. *Congruent* trials are those where the probe (white rectangle) is presented at the same spatial location as the pain face. *Incongruent* trials are those where the probe follows the same spatial location as the neutral face. Each trial type was presented 24 times for each level of facial pain display (LFE, MFE, HFE) and the inter-trial interval was set to 200 ms. The task began with 15 practice trials consisting of neutral face-pairs, none of which appeared in the main trials. The experiment itself consisted of 144 trials. The probe detection task was programmed and presented using the INQUISIT Millisecond software package (INQUISIT 2.0) on a Hewlett Packard computer with a 15-inch color monitor. INQUISIT measures reaction times (RTs) with millisecond accuracy [11].

2.5 Pain ratings

At the end of the experiment, participants were asked to rate each picture on pain intensity using a 0-10 NRS. Pictures were presented on a computer screen using Office PowerPoint. Pictures were presented in randomized but fixed order across participants. Parents were instructed to make written ratings of pain intensity and were encouraged to proceed as fast as possible. Picture ratings were averaged for each level of facial pain display (NFE, LFE, MFE, HFE) resulting in 4 mean pain intensity ratings ranging from 0-10. This allowed us to check whether differences in facial expressiveness of the pictures matched differences in parents’ pain intensity ratings.

2.6 Procedure

All participants were invited by phone and received standardized information about the study. When parents and children provided consent, they were invited to the laboratory at Ghent University where the study was conducted. A letter confirming their appointment was

sent to them. Upon arrival at the lab, one of two experimenters accompanied the parent and child to the test-room. Participants were explained that we were interested in “how parents and children think and feel about the pain that children experience”. Parents were instructed about having to perform a computerized task. Furthermore, the pain procedure was described, and the thermal heat stimulator (Contact Heat Evoked Potential; CHEPS; Medoc®) was shown (cfr. second part of larger study). After obtaining written parental and child consent, experimenter 1 stayed with the child in the test-room while experimenter 2 accompanied the parent to an adjacent room. Before performing the pictorial dot-probe task, parents filled in a socio-demographic questionnaire and the measure on catastrophizing about their child’s pain and trait anxiety. Provided that some participating parents may be familiar with the schoolchildren displayed during the dot-probe task, participants were, after completion of the dot-probe task, asked to rate (yes/no) whether they knew any of the children shown at the pictures. In case of familiarity, parents would be excluded from entering the analysis. After completion of the entire study procedure, parent child dyads reunited in the test-room and were fully debriefed about the purpose of the study.

2.7 Data reduction and statistical plan

The mean reaction time (RT) on congruent and incongruent trials for each facial pain intensity level (HFE, MFE, LFE) was calculated and used as dependent variables in the analyses. The design of the investigation included a 3×2 factorial repeated measures design with facial pain intensity (low pain face/ moderate pain face/ and high pain face) and congruency (congruent / incongruent) as within subject factors. A main effect of congruency is indicative of *selective attention* to pain faces when responding is faster to probes on congruent trials (i.e. when the probe is presented at the same spatial location as the pain face) than to probes on incongruent trials (i.e. when the probe is presented at a different spatial location as the pain face). A main effect of the intensity of facial pain expressiveness is

indicative of *task interference*; i.e. increased interference is reflected by slowing down of responses on both congruent and incongruent trials with increasing threat value (i.e increasing facial pain expressiveness). Unlike the measure of selective attention, which is indicative of spatial attention, increased interference is indicative of non-spatial attention [see 25;56]. An interaction effect between congruency and facial pain expressiveness indicates that selective attention to pain faces depends upon the level of facial pain expression.

To investigate the impact of the individual difference variables, parental catastrophizing about their child's pain and parental trait anxiety were entered as covariates to the 3×2 repeated measures model. If the higher order interactions including congruency *and* facial expressiveness were significant, bias indices were calculated to aid interpretation of the direction of differences between congruent and incongruent trials. Separate bias scores were calculated for each level of facial pain expressiveness (HFE, MFE, LFE) by subtracting the average detection time on congruent trials from the average detection on incongruent trials. Positive values on the bias index indicate increased selective attention to pain faces whereas negative values are indicative of attentional avoidance of pain faces. In case the higher order interactions including congruency *and/or* facial pain expressiveness were significant, additional repeated measures ANOVAs were performed for low (- 1SD below the mean), and high (+1SD above the mean) values of the centered moderator variable (i.e, parental catastrophizing about their child's pain/trait anxiety). Moderation analyses followed the procedure outlined by Holmbeck et al. [21].

3. RESULTS

3.1 Participant characteristics

Twelve parents were discarded from analyses because they indicated to be familiar with one or more of the children shown during the dot-probe task. In addition, one other parent was excluded since not being able to perform the dot-probe task with two hands, which

caused delayed responding ($Z_{\text{meanRT}} = 4.72$). Analyses are based upon the remaining sample of 52 parents. Parents reported levels of catastrophizing about their child's pain ($M = 17.06$; $SD = 7.71$) which are comparable to mean levels obtained in other samples of parents of schoolchildren [see e.g. 14]. Parents' level of trait anxiety ($M = 34.35$; $SD = 8.34$) was comparable to mean levels obtained in non-clinical adult samples [see e.g. 25]. Pearson correlation analyses indicated that parental catastrophizing about their child's pain was not significantly correlated with parent's level of trait anxiety ($r = .16$, ns). Furthermore, there were no significant correlations between parental age and parental catastrophizing ($r = -.20$, ns), and trait anxiety ($r = -.06$, ns). Mothers and fathers did not significantly differ on their levels of catastrophizing ($t(50) = .22$, ns) and trait anxiety ($t(50) = .01$, ns).

3.2 Picture ratings

Picture ratings were examined using repeated measures ANOVA. Results indicated significant differences between picture ratings of pain intensity of the three pain expression levels ($F(3,49) = 309.12$, $p < .0001$). Differences between ratings were in the expected direction. Specifically, contrasts revealed that high expressive pain faces ($M = 6.61$; $SD = 1.90$) were rated significantly higher than moderate expressive pain faces ($M = 4.89$; $SD = 1.87$; $F(1,51) = 428.31$, $p < .0001$). Moderate expressive pain faces were rated significantly higher than low expressive pain faces ($M = 3.34$; $SD = 1.73$; $F(1,51) = 273.38$, $p < .0001$) and low expressive pain faces were also rated significantly higher than neutral faces ($M = 1.57$; $SD = 1.36$; $F(1,51) = 143.41$, $p < .0001$). Neither parents' level of trait anxiety, nor parental catastrophizing correlated significantly with parents' pain ratings of children's pictures displaying various levels of pain expressiveness (all r s $< |.09|$, ns).

3.3 Attentional bias analyses

3.3.1 Data preparation

Trials with errors were discarded from analyses. The number of errors made by participants ranged from 0 to 5 ($M = 0.90\%$). In addition, RTs shorter than 200ms or longer than 2000ms were also discarded, as these can be considered as outliers. Furthermore, probe detection latencies that were three standard deviations above or below the individual mean latency time were also excluded from statistical analyses [25]. The number of outliers per participant ranged from 0 to 5 ($M = 1.57\%$). Statistical analyses were run on 97.5% of the data.

3.3.2 Attention to pain faces: overall effects of congruency and facial pain expressiveness

Mean RTs on different trial types are presented in Table 1. The RTs were analyzed using a 3 (facial pain intensity: N-LFE /N-MFE / N-HFE) \times 2 (congruency: congruent / incongruent) repeated measures analysis of variance (ANOVA). A main effect of congruency was found ($F(1,51) = 4.66, p < .05$) indicating that participants preferentially allocate attention towards painful faces: i.e. responding was faster for congruent trials ($M = 563\text{ms}$) than for incongruent trials ($M = 568\text{ ms}$). Furthermore, there was also a significant main effect of facial pain expressiveness ($F(2,50) = 3.58, p < .05$): RTs slowed down with increasing facial expression of pain ($M = 562\text{ ms}$ for LFE trials; $M = 564\text{ ms}$ for MFE trials and $M = 570\text{ms}$ for HFE trials). This main effect indicates increased task interference with increasing levels of facial pain expressions and suggests non-spatial components of attention are also involved in attending to pain faces. Contrasts indicated that RTs to HFE and MFE trials were significantly slower than RTs for LFE trials ($F(1,51) = 7.98, p < .01$; $F(1,51) = 5.50, p < .05$, respectively). RTs on HFE trials and MFE trials were not significantly different ($F(1,51) = 0.16, \text{ns}$). The interaction between facial pain expressiveness and congruency did not reach significance ($F(2,50) = 0.58, \text{ns}$) indicating that selective attention to pain faces is comparable for different levels of the children's facial pain expression.

Insert Table 1 about here

3.3.3 Attention to pain faces: the role of parental catastrophizing

To investigate whether parental attentional processing varies with different levels of parental catastrophic thinking about their child's pain, a 3×2 repeated measures ANOVA was performed with parental catastrophizing entered as covariate. In addition, in order to control for possible effects of trait anxiety, parents' level of trait anxiety was also entered as a covariate to the model.

Analyses revealed a significant two-way interaction between facial pain expressiveness \times catastrophizing ($F(2,48) = 7.14, p < .001$). This two-way interaction is of interest with regard to interference of facial expressions on probe responding [25;56]. To interpret the significant two-way interaction two repeated measures ANOVAs were performed with level of facial pain expressiveness as within subject factors (LFE, MFE, HFE) and high (+1SD above the mean) or low values (-1SD below the mean) of parental catastrophizing as covariate. Analysis of Variance indicated that the effect of varying levels of facial pain expressiveness upon RTs was significant for high catastrophizing parents ($F(2,49) = 7.54, p < .001$). Contrasts indicated that higher levels of facial pain expression were associated with increased interference (i.e. slower responding), but only for parents who reported high levels of catastrophizing. RTs to HFE ($M = 574$) and MFE ($M = 570$) did not significantly differ ($F(1,50) = .90, ns$), yet both RTs were significantly slower than RTs to LFE ($M=560$; $F(1,50) = 17.09, p < .0001$; $F(1,50) = 6.22, p < .05$, respectively). For low catastrophizing parents, this pattern failed to reach significance ($F(2,49) = 2.95, ns$).

We also found a significant three-way interaction between facial pain expressiveness \times congruency \times catastrophizing ($F(2,48) = 3.61, p < .05$) indicating that selective attention to certain levels of facial pain expression is different for high and low catastrophizing parents. To interpret the significant three-way interaction, two repeated measures ANOVAs were

performed with the attentional bias indices for HFE trials, MFE trials and LFE trials as within subject factors and higher (+1SD above the mean), or lower values (-1SD below the mean) of parental catastrophizing as covariate. As shown in Figure 1, bias indices for LFE, MFE and HFE for low catastrophizing parents indicate a cross-over interaction with bias indices for high catastrophizing parents. Analyses showed that bias indices did not significantly differ within low catastrophizing parents $F(2,49)=1.56$, ns). Similarly, differences between bias indices also failed to reach significance within high catastrophizing parents ($F(2,49)=2.17$, ns). However, additional univariate ANOVAs for each bias index separately indicated a significant effect of parental catastrophizing upon the attentional bias index for LFE pictures. Contrary to expectations, higher levels of catastrophizing were *negatively* associated with the attentional bias index for LFE, suggesting a higher tendency to shift attention away from low expressive pain faces ($F(1,49)=4.31$, $p < .05$) when level of catastrophizing increases. The pattern for MFE and HFE were in the opposite direction with higher catastrophizing parents showing increased attention for MFE and HFE as compared to LFE, yet the association between catastrophizing and the bias indices for MFE and HFE failed to reach significance (both $F(2,49) < |1.57|$, ns).

Insert Figure 1 about here

4. DISCUSSION

The present study investigated, by means of a pictorial dot-probe task, parental selective attention to children's facial pain display and the extent to which parental attention is modulated by the intensity of child's facial pain displays and parental catastrophizing about their child's pain. We hypothesized that (1) parents would selectively attend to children's facial pain displays, (2) selective attention to pain faces would increase with higher levels of facial pain expression, and (3) parental catastrophizing about the child's pain would interact

with the effects of facial pain intensity such that even mild levels of facial pain expression attracts more attention in high catastrophizing parents. To explore the unique value of parental catastrophizing we controlled for parental trait anxiety in all analyses. In general, results indicated that parental attentional processing of the child's pain is sensitive to characteristics of the child in pain (i.e. level of child facial pain expression), characteristics of the parent (i.e. parental catastrophizing, but *not* parental trait anxiety) and the interaction between these variables. Findings were, however, not entirely as expected. In particular, while our findings provide evidence of parental selective attention to children's pain faces (i.e. parents' responding was faster to congruent than to incongruent trials), parental attentional bias to pain faces did, however, not increase with increasing levels of children's facial pain displays. Rather, a task interference effect was observed on presentation of threatening information: responding to the probe slowed down on both congruent and incongruent trials when facial pain expressiveness increased. This was particularly pronounced in those parents who have catastrophic thoughts about child's pain. Finally, findings also revealed that attentional bias to children's painful faces is different for high and low catastrophizing parents. The observed pattern was opposite to expectations. Specifically, whereas high and low catastrophizing parents' attentional bias to higher child facial pain expression did not differ, only *low* catastrophizing parents, but not high catastrophizing parents, showed attentional bias to low expressive child pain faces. Parents with higher levels of catastrophizing increasingly attended away from low painful faces.

The present study is important as it is one of the first that addressed observers' attentional processing of another's pain. In fact, and to the best of our knowledge, this study is the first that demonstrated parental selective attention to children's facial pain expressions. As far as we know, only one previous study has investigated selective attention to pain faces. Specifically, Kathibi et al. [24] investigated, also by means of a pictorial dot-probe paradigm,

selective attention to pain faces in a sample of chronic pain patients and a healthy control sample, yet failed to find strong evidence for selective attention to pain faces in both samples. Although various factors may account for divergent findings, it may be most plausible that failure to find attentional bias to pain faces is due to insufficient interpersonal salience of another's facial pain displays. The interpersonal nature of the Khatibi et al. study drew solely on the use of painful faces as stimuli. The present study goes beyond the Khatibi et al. study by embedding observers' attentional processing of pain faces in an interpersonally salient context. Specifically, parents were informed their own child would undergo a similar pain procedure as the children that were shown during the dot-probe task. Accordingly, children's facial pain displays were, within the context of the present study, much more likely to be interpersonally relevant, and therefore, capable of engaging parent's attention to the location of threat.

Our results suggest that not only *spatial*, but also *non-spatial* components of attention are likely to be involved in attending to painful faces. Interestingly, different attentional components were revealed in different ways. Specifically, findings indicated that low facial pain displays were sufficiently but also, as compared to higher facial pain displays, equally capable of engaging parents' attention to the spatial location of threat. Increasing facial pain intensity was qualified by having a non-spatial effect upon attention; i.e. findings indicated increased interference (i.e. delayed responding) with increasing facial pain intensity. Such interference effects have been reported in earlier studies on attentive processing of threat [25;56]. Furthermore interference effects are consistent with theories conceptualizing selective attention to pain as a mechanism that facilitates responding to potentially dangerous stimuli, and therefore interrupts *ongoing* behavior (i.e. probe responding in the present study) [13;46]. Possibly, the severity of facial pain displays may have had a non-spatial effect on attention by recruiting additional attentional resources in proportion to the level of threat

perceived. Spatial attention effects, on the other hand, may be affected only by the relative attentional priority given to each location [25;28;35;56]. Such localization may facilitate the conscious assessment of danger severity. Specifically, a picture sharing features with previously encountered threats could lead to attention at the relevant location in a relatively all or none manner, prior to full identification, and independent of the threat value or meaning that is encoded after full analysis [28;50;56].

High catastrophizing parents may be particularly prone to extensive processing of threat. Specifically, previous findings have indicated that for high catastrophizing parents, observing their child in pain primarily elicits an aversive state of increased self-oriented distress [3;18]. Further, findings have also indicated frequent catastrophizers report significant difficulty in suppressing or disengaging attention from pain-related thoughts [42;43;45]. Provided such elaborative processing of threat may hinder the activation of resources necessary to disengage from negative pain-related thoughts and feelings, and hence, compromise re-orienting and responding to environmental stimuli (i.e. probe responding) [7;42;43;50], it may be no surprise increased interference was particularly pronounced for high catastrophizing parents.

Finally, findings indicated, that only low, and not high catastrophizing parents selectively attended low pain faces. In fact, higher catastrophizing parents showed an increasing bias away from low painful faces. Although further research is needed, one plausible explanation is that, for high catastrophizing parents, initial automatic orienting to pain faces instigates the urge to avoid or escape the child's pain as an attempt to alleviate the aversive mood state elicited by viewing the child in pain [3;18]. An exposure time of 500 ms is long enough to allow shift of attention between the members of a stimulus pair, and hence, may allow avoidance [32]. Yet, we do not know whether this pattern would generalize to their own child's pain expression. In addition, it is unclear why this pattern was not observed for

higher facial pain displays. Possibly, and extending the above account on interference, it may be that with higher facial pain displays, catastrophizer's avoidance tendencies may increasingly conflict with and be compromised by increased difficulty disengaging from pain [6;17;50]. To date, hypervigilant-avoidance phenomena are well known from anxiety research [see e.g. 26;27;33;51], yet await verification for pain-related stimuli.

A number of limitations deserve consideration, each of which point to directions for future research. First, the present study did not include a neutral-neutral comparison group. It is therefore unclear whether attentional bias to child pain faces is due to speeded processing of congruent trials (i.e. indicative of hypervigilance) or slowed processing of incongruent trials (i.e. indicative of difficulties in disengaging from pain) [25;37;42;43;44;50]. In addition, the present study also used one stimulus duration (SOA=500ms) and so did not allow investigation of the time course of attentional biases (e.g. assessing avoidance following initial vigilance) [26;27;31;33;51]. Future studies using the dot-probe paradigm to assess attention to another's pain (behavior) may benefit from including both a neutral-neutral comparison group as well as varying exposure durations. Second, measurement of attentional processing by means of the dot-probe task is limited in that attention can only be inferred indirectly by the registration of manual response latencies. Tracking participants eye movement while viewing another's pain is likely to provide a more direct index of attentional processing. Furthermore, applying eye-tracking technology provides a continuous index, and hence, allows to precisely study the temporal dynamics of observers' attentional biases [2;30;51]. Third, parents attentional processing was assessed while viewing faces of unfamiliar children. Findings from recent brain imaging have shown that parents process the face of their own child in a manner that differs from how they process the face of an unfamiliar child and suggest increased allocation of attention to own children's faces [19;29]. Accordingly, studies are needed that also investigate parental attention to their own child's

pain. Fourth, besides facial displays of pain, other pain behaviours, such as guarding or rubbing, may also cue pain to others [9;41;53]. It will be interesting to investigate whether different types of pain behaviours differentially engage observers' attentional resources [9]. Finally, the present sample consisted of parents of school children. Further research is needed to establish whether the results generalize to parents who have been extensively exposed to pain: i.e. parents of children who suffer chronic/clinical pain.

In spite of these limitations, the present findings are important as they are among the first of their kind. Although preliminary, results attest to the importance of child facial pain displays, parental individual characteristics and the interaction between both in understanding parental attentional processing of child's pain. Further research is needed to replicate and extend the current findings by elucidating the temporal dynamics of observers' (parents') attentional processing of another's (child's) pain, its determinants and consequences.

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FIGURE LEGENDS

Figure 1: Average bias indices for low expressive pain faces (LFE), moderate expressive pain faces (MFE) and high expressive pain faces (HFE) as a function of lower (-1SD below the mean) and higher (+1SD above the mean) levels of parental catastrophizing about their child's pain.

* $p < .05$

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Table 1: Mean reaction times (in milliseconds) and standard deviations (SD) on congruent and incongruent trials for low, moderate and high painful expressions.

	Congruent trials	Incongruent trials
Low facial pain expression	560 (82)	564 (87)
Moderate facial pain expression	560 (81)	568 (93)
High facial pain expression	569 (89)	570 (85)

Figure 1 : Parental catastrophizing x bias indices for LFE, MFE and HFE

