THE SOCIAL FUNCTION OF PAIN CATASTROPHIZING IN CHILDREN AND ADOLESCENTS

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GENERAL INTRODUCTION

PAIN IN CHILDREN AND ADOLESCENTS: A COMMON EXPERIENCE

Pain is an integral part of life and a well-known experience to all human beings. Much of the literature, however, concerns pain in adulthood (see e.g., Mäntyselkä et al., 2001; Picavet & Schouten, 2003; Von Korff, Dworkin, Le Reseche, & Kruger, 1988) An understanding of pain in children is emerging. It is becoming increasingly clear that infants are well endowed to experience pain from birth on (Anand, Phil & Carr, 1989; Fitzgerald, 1993), with this capacity enduring throughout the lifespan (Walco, 2004). Children can experience many different types of acute, recurrent, and persistent pain. The most common locations of pain in children appear to be the back, stomach, head and limbs (Goodman & McGrath, 1991; Huguet & Miró, in press). The overall prevalence of pain tends to increase with age, and girls generally report higher levels of pain compared to boys (Unruh, 1996; Unruh & Campbell, 1999). A common way to classify pain is to consider it along a continuum of duration. Pain that is of relatively brief duration (hours, days or even weeks), and typically characterized by a sudden onset and a demonstrable etiology such as noxious or tissue damaging stimulation, is frequently referred to as acute pain. Chronic pain is often defined as any prolonged pain that lasts as minimum of 3 months or any pain that recurs throughout a minimum period of 3 months (McGrath, 1999). In addition, whereas acute pain originates mainly from evident physical or organic causes, chronic pain is often experienced in the absence of a well-defined organic etiology (Kashikar-Zuck, 2006).

Everyday hurts or pains are an experience common to all children and, in normal circumstances, they constitute the child's major experience with pain. Studies in the natural social environment of preschoolers and young school-age children find an incidence of close to one painful event every 3 waking hours (Fearon, McGrath, & Achat, 1996). Similarly, recent findings indicated that two-third of school children reported having pain at least once a month, one-third at least once a week, and 6% reported experiencing pain symptoms every day. Among the children who reported pain, one-half reported co-occuring or multiple pain symptoms (Petersen, Brulin, Bergström, 2006). Although the majority of pain complaints in children are short lasting and only temporarily disabling, a significant number of children does not recover within a reasonable span of time. In fact, there is a high prevalence of chronic and recurrent pain in children and adolescents (Huguet & Miró, in press; Perquin et al., 2000a; Petersen et al., 2006). For example, in a Dutch study in children and adolescents, a quarter of the respondents reported chronic pain, with one-third of them experiencing frequent and intense pain (Perquin et al., 2000a). In addition, chronic pain in children and adolescents is not only common, it seems to persist in a considerable proportion; 48% and 30% of children and adolescents who were experiencing chronic pain at baseline still tend to experience chronic pain at one-year and two-year follow-up, respectively (Perquin et al., 2003).

PAIN IN CHILDREN AND ADOLESCENTS: A TROUBLESOME EXPERIENCE?

Pain is not only common and universal to all human beings, it is vital to one's survival. Findings indicating individuals with a congenital absence of pain typically incur cumulative injuries and die early (Melzack, 1973), reveal pain undoubtedly serves protective functions. Specifically, the potential for pain to grasp the attention of the sufferer and motivate to actions aimed at reducing, avoiding or escaping from pain probably has evolutionary origins because of its adaptive value (Eccleston & Crombez, 1999; Williams, 2002). Despite its inherent adaptive nature, numerous findings have indicated pain can inflict a significant burden on individuals. For example, pain can lead to significant interference with daily functioning such as impaired school functioning, impaired physical functioning, and impaired peer and social functioning (Gauntlett-Gilbert & Eccleston, 2007; Kashikar-Zuck, Goldschneider, Powers, Vaught, & Hershey, 2001; Konijnenberg et al., 2005; Peterson & Palermo, 2004). Pain has also been found to have negative effects on emotional functioning. In particular, depressive and anxious symptomatology and lower general self-esteem can be part of the picture (Eccleston, Crombez, Scotford, Clinch, & Connell, 2004; Varni, Rapoff, Waldron, Bernstein, & Lindsley, 1996). Children consistently describe pain as something that hurts and makes them feel bad (Craig, Stanford, Fairburn, & Chambers, 2006; McGrath et al., 2000). The experience of persistent pain may also hamper normal development of independence and autonomy (Barlow, Harrison, & Shaw, 1998; Eccleston, Wastell, Crombez, Jordan, in press; Walco, 2004; Walco & Harkins, 1999). In addition, pain reports in childhood and adolescence are associated with an increased risk of having chronic pain syndrome in adulthood (Brattberg, 2004; Fearon & Hotopf, 2001; Taddio, 1999).

Pain in children and adolescents is associated with a burden for their families, in particular for their parents (Palermo, 2000). Caring for a child with (chronic) pain places considerable demands upon parents. For example, parents of children with chronic pain report restrictions in personal and family activities and marital problems (Hunfeld et al., 2002; Lipani & Walker, 2006). In addition, studies have demonstrated high levels of depression, anxiety and parenting stress in children and adolescents with chronic pain (Eccleston et al., 2004). Specifically, parents may struggle to adapt to a life very different than expected, a life fraught with uncertainty, fear, guilt, helplessness, frustration, and loss (Barlow et al., 1998; Jordan, Eccleston & Osborn, 2007). Families may also experience the burdens of financial obligations, and lost personal time because of their child's health care consultations and medication use (Hunfeld et al., 2001; Perquin et al., 2000b).

These findings clearly indicate that pain is not simply a sensory experience, but one that is intrinsically interwoven with suffering or emotional distress, both for the child in pain as for their social environment. However, not all children who are in pain suffer or are disabled to the same extent (Gauntlett-Gilbert & Eccleston, 2007; Palermo, 2000). Similarly, pain does not affect all families equally; relationships between childhood pain and family adjustment/functioning may vary to a great extent (Drotar, 1992; Palermo 2000). This

emphasizes the importance of assessing for pain in children ánd for factors contributing to negative pain outcomes. Observations of high intervariability in the pain sufferer's and cargivers' responses has lead to fundamental changes in the theoretical conceptualisation and management of pain.

THEORETICAL APPROACHES TO PAIN

Any contemporary model of pain includes both medical and psychosocial factors and acknowledge the reciprocal influence between these factors in understanding pain. Early theories of pain, however, were very different. Descartes' explanation of pain assumed sensory experience of pain resulting directly from stimulation of specific noxious receptors. Two major assumptions have been inherited from Descartes. First, that of a one-to-one relationship between the amount of damage (or nociception) and the pain experienced. Second, the separation of mind and body. Building on Descartes' notion of pain, a biomedical approach to pain has predominated the conceptualization and treatment of pain for a long time. The traditional biomedical model of pain focuses on structural and biological abnormalities to explain the occurrence and the maintenance of pain. The biomedical perspective assumes linear one-to-one relationships between tissue damage, pain and disability (Waddell, 1992). From a biomedical point of view, however, several observations regarding pain are difficult to explain. For example, like adults, children can experience pain without tissue injury or any apparent injury at all. They can also sustain injury without experiencing pain, and can experience very different pains from the same type of tissue damage (Kashikar-Zuck, 2006). In addition, there is also a loose relationship between pain intensity and disability (Gauntlett-Gilbert & Eccleston, 2007). Biomedical models of pain are limited by their reductionistic (i.e. assuming a direct link between disease and physical pathology) and exclusionary (i.e. assuming psychological, social and behavioural mechanisms are not important in disease) conceptualisation of pain (Asmundson, Norton & Vlaeyen, 2004; Turk & Flor, 1999), thereby failing to recognize the importance of variability in response to pain.

With the postulation of the 'Gate Control Theory', Melzack and Wall (1965) marked a turning point in our understanding of pain in two respects. First in terms of the mechanisms of the transmission and modulation of nociceptive signals, and secondly in terms of its recognition of pain as a psychophysiological phenomenon resulting from the interaction between physiological and psychological events. In contrast to Descartes' idea about pain, the transmission of information about painful events in the periphery is not a simple one-way system. The Gate Control Theory suggested that several processes mediated by the central nervous system, including cognition and affect, could directly impact the transmission and perception of nociceptive sensory information from the periphery. The Gate Control Theory clarified that tissue damage *may* initiate a sequence of neural events that *may* lead to pain, but many other factors, both cognitive and affective factors, may alter the sequence of nociceptive transmission and thereby modify a persons' pain perception. Inspired by the Gate Control

Theory, the International Association for the Study of Pain (IASP) reached consensus in defining pain as 'an unpleasant sensory and emotional experience associated with actual or potential tissue damage' (International Association for the Study of Pain Task Force on Taxonomy, 1994, p. 210). This definition recognizes that pain has unique sensory and perceptual characteristics, that there is no absolute correspondence between pain and tissue damage and that it is an unpleasant emotional experience (Eccleston & Crombez, 1999). This definition, however, misses explicit reference to (1) cognitive-motivational dimensions of the pain experience and to (2) social or communication features of pain. Both aspects, however, have been identified as essential features of the pain experience (Eccleston & Crombez, 1999; Hadjistavropolous & Craig, 2002).

The shift away from the perception of pain as a purely sensory phenomenon to pain also comprising psychological (cognitive, affective, behavioural) and social or contextual components has given rise to a new perspective on pain; a *biopsychosocial* perspective. At present, it is generally accepted that the association between physical impairment and pain intensity and pain-related disability is loose and that psychosocial factors play a crucial role in understanding pain and pain-related problems (Hunfeld et al., 2001; Claar & Walker, 2006).

Specifically, it has become increasingly clear that although pain is commonly defined as private, highly personal, and subjective, it is, *in essence*, also a social experience; Pain, as an archetypal sign of threat, does not only demands the attention of the sufferer (Eccleston & Crombez, 1999), it also demands, through behavioural manifestations, the attention and potentially the concern of others in the social environment (Hadjistavropolous & Craig, 2002; Craig, 2004). Other's responses, in turn, might have a tremendous impact upon the sufferer's pain experience. For example, families may influence children's experiences of pain through family members' own experiences of pain and use of coping strategies in dealing with their own pain and their child's pain (Goodman & McGrath, 2003; Schanberg et al., 2001; Thastum, Zachariae, Scholer, Bjerring, & Herlin, 1997), as well as by a range of diverse caregiving behaviours that differentially impact upon the child's pain responses (Peterson & Palermo, 2004; Walker, Claar & Garber, 2002). A comprehensive understanding of pain as a *social* experience; i.e. the dynamic interplay between a sufferer's pain experience and the social environment in which pain emerges, requires consideration of social or communication features of the pain as these are important determinants of pain experience, pain expression and related disability and suffering (Hajistavropolous & Craig, 2002; Craig, 2004).

THE SOCIO-COMMUNICATIONS MODEL OF PAIN

The socio-communications model of pain, based upon Rosenthal's (1982) model of non-verbal communication, was developed as a heuristic framework to assist in understanding the complex social interactions among children in pain and their caregivers (Hadjistavropolous & Craig, 2002; Prkachin & Craig, 1995). Nonverbal communication is conceived as a process in which internal experiences are communicated through behaviour to the world. The socio-

communications model encompasses not only non-verbal but also verbal communications of pain. As illustrated in Figure 1, the model directs attention to the dynamism and complexity of the information transmission process between sufferers and observers. The model describes experiential, encoding and decoding processes that may occur during an episode of pain. The sequence typically would be initiated by a threat to the integrity of body tissue, characterized in Figure 1 as the occurrence of a real or potential painful stimulus or tissue damage and information would be transmitted and processed centrally in the brain and experienced as pain. In this A-B-C model, the experience of an internal state (A), may be encoded in particular features of expressive behaviour (B) permitting an observer to draw inferences (C) about the experience of the sender. In turn, the actions or responses of the observer could have some impact upon both A and B.

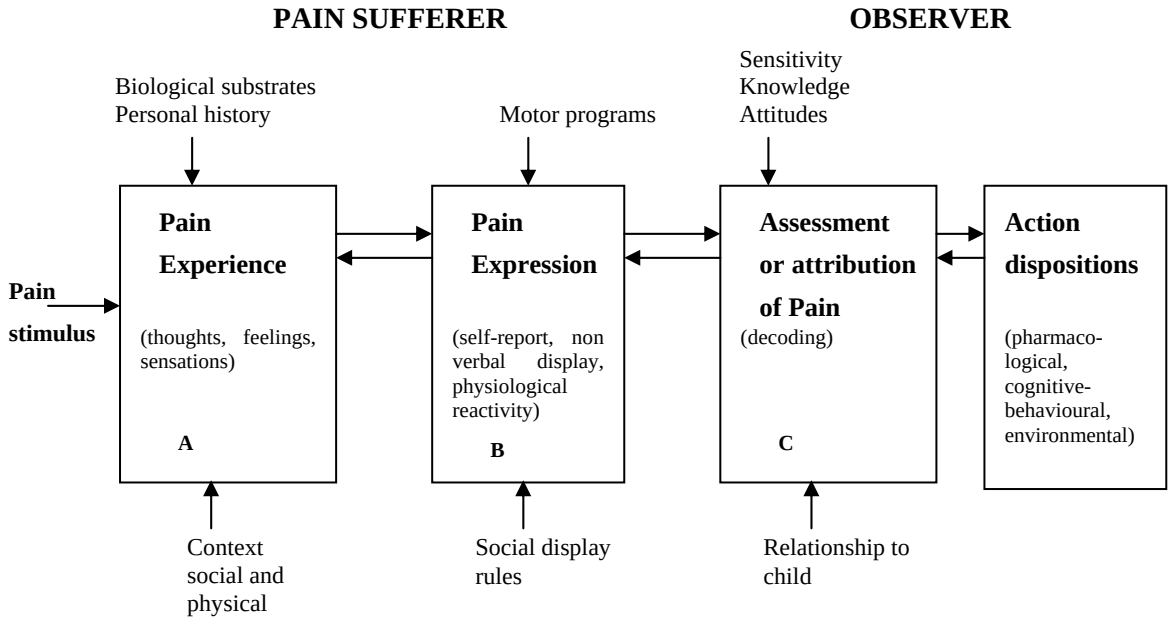

Figure 1: The socio-communications model of pain (Craig, 2002).

Children become increasingly capable of communicating their pain experience through a remarkable variety of actions, ranging from the use of language to diverse nonverbal actions. The latter include (1) paralinguistic vocalizations, such as crying or moaning; (2) other nonverbal qualities of speech, such as volume, hesitancies or timbre; (3) visible physiological activity, such as pallor, sweating or muscle tension; (4) bodily activity, including involuntary reflexes and purposeful action; and (5) facial expressions (Craig, Prkachin & Grunau, 2001). Despite the wide use of pain behaviour as a unitary concept in a lot of pain research (Prkachin, 1986), the communicative value of these behaviours may be secondary to other functions. Different behaviours may serve different functions (Sullivan et al., 2006a; Williams, 2002). For example, limb and bodily activities primarily serve to avoid and terminate injury or to prevent

the body from further harm. In contrast, speech and facial expression can control pain only indirectly. They function, above all, as social communications that convey distress and may recruit help of others (Hale & Hadjistavropolous, 1997; Poole & Craig, 1992). Sensitivity to another person's pain can yield adaptive benefits to both the suffering person in pain and the observer. For the sufferer, there are adaptive advantages to being able to engage adult care from the earliest moments of life (Craig, 1992; Hadjistovropolous & Craig, 2002; Johnston, Stevens, Craig, & Grunau, 1993; Prkachin & Craig, 1995). For example, a child expressing pain might derive benefits if expression is followed by caregiving reactions aimed at recovery or survival. For the observer, signals of pain in another may lead to actions ranging from decisions to escape personal threat to providing appropriate care to the sufferer. The potential for pain to grasp the attention of others, and the substantial personal and social consequences arising from another's sensitivity to the sufferers' expression further suggests the usefulness of an evolutionary explanation in understanding the origins and operation of this capability (Craig, 2004; Williams, 2002; Williams & Craig, 2006).

As indicated by the socio-communications model, there is a multitude of factors that might influence the extent to which a sufferer's pain becomes manifest socially, and hence, is expressed behaviourally. To date, the operant model, as originally proposed by Fordyce (1976), is one of the major models that has had a major influence upon the understanding of pain behaviour. Of relevance within the context of pain communication, operant behavioural principles emphasizing the role of external social learning influences have often been invoked to understand the development and maintenance of pain and pain-related behaviours (Fordyce, 1976). The impact of family responses on child pain and pain behaviour has gained considerable attention in recent years (see e.g., Chambers, Craig, & Bennett, 2002; Claar, Simons, & Logan, in press; Walker et al., 2002; 2006; Walker & Zeman, 1992). It has become increasingly clear, however, that operant principles alone cannot fully capture the complexity of pain and related behaviour (Crombez & Eccleston, 2002; Williams, 2002). Specifically, not all pain behaviours are shaped by external social contingencies. The facial display of pain, for example, has been shown to be innate and universal to all human beings (Prkachin, 1992; Williams, 2002). Hence, the adaptive function of these behaviours might be overlooked (Craig, 2004; Williams, 2002). In addition, observations may well go beyond what could be expected or explained by operant principles alone (Newton-John, 2002). For example, cognitive dimensions of pain such as a child's appraisal of the pain, as well as emotional dimensions, such as pain-related anxiety or fear, have found to be important in understanding the impact of other's responses upon pain and related behaviour. (Claar et al., in press; Langer, Chen, & Luhmann, 2005; Piira, Taplin, Goodenough, & Von Baeyer, 2002).

A comprehensive understanding of pain also requires appreciating the adaptive function of pain and related behaviour as well as an understanding of cognitive-affective factors that may modulate the experience and expression of pain. We will argue below that pain catastrophizing, which is an important cognitive-affective construct for pain experiences (Sullivan et al., 2001), might be particularly relevant in this regard.

PAIN CATASTROPHIZING: DEFINITION

Interest into the concept of catastrophizing in the context of pain and pain-related coping has increased over the past years and has resulted in a growing amount of literature pointing to its important role in understanding deleterious pain outcomes, both in clinical and non-clinical populations (Sullivan, Bishop, & Pivik, 1995; Sullivan et al., 2001). Catastrophic thinking about pain has been conceptualized in different ways. Spanos, Radtke-Bodorik, Ferguson, & Jones (1979) classified individuals as catastrophizers when their thought reflected worry, expectations of negative outcome, and the inability to divert attention away from the pain. Rosenstiel & Keefe (1983) have conceptualized catastrophizing in patients with chronic low back pain primarily in terms of helplessness and pessimism concerning one's ability to deal with the pain experience. Chaves and Brown, based upon interview responses from dental patients, described (1987) catastrophizers as individuals who have a tendency to magnify or exaggerate the threat value or seriousness of pain sensations. All these descriptions have in common the idea that pain catastrophizing is a form of negative pain-related cognition, but they differ in the specific content of this cognition.

An important contribution in the study of pain catastrophizing was the development of the Pain Catastrophizing Scale (PCS; Sullivan et al., 1995; Osman et al., 1997; Van Damme, Crombez, Bijttebier, Goubert, & Van Houdenhove, 2002). The PCS is a 13-item self-report measure for use in clinical and non-clinical patients with pain and pain-free individuals, and acute and chronic pain. The items were selected from the above described conceptualizations of catastrophizing. On the basis of a factor analytic study, Sullivan et al. 1995 suggested that catastrophizing could be viewed as a conceptually integrated concept that comprised three related components: rumination, magnification and helplessness. The PCS has recently been adapted and validated in a sample of school children and children with chronic pain (Pain Catastrophizing Scale for Children; PCS-C; Crombez et al., 2003). Findings revealed the three factor structure of the PCS was replicated in the PCS-C, and was invariant across age groups and gender (Crombez et al., 2003).

Although a single precise definition of pain catastrophizing has not been endorsed, there is general agreement now that catastrophizing involves a negative cognitive and affective orientation to pain (Ellis & D'Eon, 2002; Jones, Rollman, White, Hill, & Brooke, 2003) and is characterized by an individual's tendency to focus on, and exaggerate the threat value of painful stimuli and negatively evaluate one's own ability to deal with pain (Sullivan et al., 1995; Sullivan et al., 2001).

Regarding the utility and distinctiveness of catastrophizing, the issue of a potential redundancy between catastrophizing and related cognitive-affective constructs has been raised early on (Sullivan & D'Eon, 1990; Turner & Aaron, 2001). For example, some have suggested catastrophizing may reflect the cognitive component of depression (Sullivan & D'Eon, 1990). Catastrophizing may also overlap with affective traits such as negative affectivity (Turner & Aaron, 2001). Both negative affectivity and pain catastrophizing have been described in terms

of excessive focus on negative aspects of situations, rumination, and heightened levels of distress (Costa & McCrae, 1992; Crombez, Eccleston, Van den Broeck, Van Houdenhove, & Goubert, 2002). Findings of several studies in adults, however, do not support the position that catastrophizing is conceptually confounded with depression or negative affectivity; effects of catastrophizing cannot be accounted for by depression or negative affectivity (Crombez et al., 2002; Goubert, Crombez, & Van Damme, 2004; Sullivan et al., 1995). It has been suggested, however, that persons high in negative affectivity may be prone to catastrophizing. As such, negative affectivitiy might be conceived of as a vulnerability factor for catastrophizing (Goubert et al. 2004, Turner & Aaron, 2001).

To date, pain catastrophizing has been mainly investigated in adults. Here, considerable research has indicated pain catastrophizing in adults is associated with negative pain outcomes (Sullivan et al., 2001). Limited attention has been devoted to pain catastrophizing in pediatric pain research. Available findings in children, however, point to the importance of assessing for pain catastrophizing in children: i.e. pain catastrophizing in children is also associated with negative pain outcomes (Crombez et al., 2003; Hermann, Hohmeister, Zohsel, Ebinger, & Flor, 2007; Kashikar-Zuck et al., 2001).

Following an overview of the evidence indicating heightened associations between catastrophizing and a diversity of negative pain outcomes in adults and children, including its impact upon understanding gender differences in pain, we will discuss theoretical approaches to catastrophizing that highlight catastrophizing may exert its negative impact upon pain outcomes both (1) through its associated effect upon the sufferer's *intra*-individual functioning as well as (2) through its impact upon the *inter*personal or social environment.

PAIN CATASTROPHIZING: MAIN FINDINGS

The most consistent finding is that catastrophizing is associated with heightened self-reports of *pain* (Sullivan et al., 2001). A multitude of studies have shown catastrophizing contributes to higher pain reports in diverse patients groups, including e.g., patients with soft tissue injuries (Sullivan, Stanish, Waite, Sullivan, & Tripp, 1998), chronic low back pain (Severeijns, Vlaeyen, Van den Hout, & Weber, 2001), osteoarthritis (Keefe, Lefebvre, Egert, Affleck, Sullivan, & Caldwell, 2000), rheumatoid arthritis (Keefe, Brown, Wallston, & Caldwell, 1989) and dental procedures (Sullivan & Neish, 1999). Heightened associations between catastrophizing and pain have also been reported in non-clinical samples (Sulivan, Rodgers & Kirsh, 2001b). For example, in their validation study of the PCS, Sullivan et al. (1995) compared undergraduate participants who were classified as either high or low in pain catastrophizing. High catastrophizers reported significantly higher levels of pain compared to low catastrophizers. Similarly, Buer and Linton (2002) found positive associations between catastrophizing and pain in a sample of adults with non-chronic spinal pain. In addition, the authors reported that catatstrophizing is present in early stages of the pain process and suggested that catastrophizing may play active part in the transition from acute to chronic pain. In order to address the

antecedent status of catastrophizing for heightened pain, some studies have investigated the prospective role of catastrophizing (Keefe et al., 1989; Picavet, Vlaeyen & Schouten, 2002; Severeijns, Vlaeyen, Van den Hout, & Picavet, 2005; Sullivan & Neish, 1999). For example, findings, in a sample of patients with rheumatoid arthritis, indicated that catastrophizing had a small but significant contribution in predicting pain intensity ratings 6 months later (Keefe et al., 1989).

Findings on the role of catastrophizing in predicting pain intensity ratings in children and adolescents are emerging. Associations are comparable as those obtained in adults (Crombez et al., 2003; Hermann et al., 2007; Lu, Tsao, Myers, Kim, & Zeltzer, 2007; Thastum, Herlin, & Zachariae, 2005). For example, Hermann et al. (2007) found that pain catastrophizing contributed to higher pain intensity ratings in a sample of healthy school children and in a sample of children with chronic pain. Similar findings have been reported by Bédard, Reid, McGrath, & Chambers (1997), in a sample of high school adolescents, and by Thastum et al. (2005) in a sample of children with juvenile idiopathic arthritis. In addition, pain catastrophizing in healthy children has also been found to be associated with lower pain tolerance; children who were highly catastrophizing showed lower tolerance in sustaining the cold water task compared to low catastrophizing children (Piira et al., 2002). To date, no study has investigated the prospective role of catastrophizing in children in the prediction of negative pain outcomes such as intensified pain.

Catastrophizing has also been found to be associated with higher levels of *emotional distress* (Keefe et al., 2000; Sullivan & Neish, 1999; Sullivan et al., 2001b; Severeijns et al., 2001). For example, adult patients undergoing a dental procedure experienced higher levels of emotional distress when they were highly catastrophizing (Sulivan & Neish, 1999). Severeijns et al. (2001), in a sample of adult patients with musculoskeletal problems, reported higher levels of patient catastrophizing were associated with higher levels of psychological distress, characterized by feelings of depression and nervousness.

Similar findings have been reported in children (Eccleston et al., 2004; Hermann et al., 2007; Kaminsky, Robertson, & Dewey, 2006). In sample of adolescents suffering chronic pain, the tendency to have catastrophic thinking about pain had a strong contribution in explaining adolescent's heightened emotional distress. Heightened associations between catastrophizing and dysphoric mood have been found both in children suffering chronic pain and in healthy school children (Hermann et al., 2007).

Catastrophizing in adults is also associated with a diverse range of *pain behaviours* (see e.g., Keefe et al., 2000; Sullivan, Tripp, & Santor, 2000). For example, Keefe et al. (2000) found that adult patients with osteoarthritis who scored high on the measure of catastrophizing expressed more pain behaviour, such as guarding and rubbing, compared to low catastrophizing patients. Catastrophizing in adults also contributes to higher use of pain medication (Severeijns, Vlaeyen, Van den Hout, & Picavet, 2005) and more and longer hospital stays (Gil, Abrams, Phillips, & Williams 1992).

Similarly, in children, pain catastrophizing has been found to be associated with more self-medication, more over the counter medication, more social support seeking (Bédard et al., 1997), and more frequent visits to health care professionals (Gil et al., 1993).

Finally, it seems that catastrophizing is also related to increased *disability* on several domains of functioning (Keefe et al., 1989; Martin et al., 1996; Sullivan et al., 1998). For example, in a sample of adult patients with soft-tissue injuries, catastrophizing contributed to higher levels of occupational disability and a greater likelihood of unemployment (Sullivan et al., 1998). Similarly, in adult patients with fibromyalgia, catastrophizing contributed to heightened levels of physical and psychosocial disability (Martin et al., 1996). In a prospective study with patients with rheumatoid arthritis, pain catastrophizing contributed to the prediction of functional impairment six months later (Keefe et al., 1989).

Heightened associations between catastrophizing and disability have also been found in pediatric samples (Crombez et al., 2003; Lynch, Kashikar-Zuck, Goldschneider, & Jones, 2006). Specifically, high catastrophizing children with chronic pain report to have more difficulty in the performance of daily activities in home, school, recreational and social domans (Crombez et al., 2003; Lynch et al., 2006).

PAIN CATASTROPHIZING: A FEMALE ISSUE?

There seem to be important gender differences in the tendency to catastrophize. Several investigations in adults have revealed that women engage in pain catastrophizing to a greater extent than men. This gender difference has been found both in healthy adults as in a diverse range of adult patients groups (see e.g., Keefe et al., 2000; Osman et al., 1997; Sullivan et al., 1995; 2000; Van Damme et al., 2002). In addition, gender differences also exist in the experience of pain, with women reporting a higher incidence of suffering, higher levels of pain, and more pain behaviour compared to men (Berkley & Holdcroft, 1999; Sullivan et al., 2000). Interestingly, catastrophizing has been found to be important in understanding gender differences in pain outcome measures such as self-reported pain intensity and pain behaviour (Keefe et al., 2000; Sullivan et al., 2000).

Regarding gender differences in catastrophizing and pain, similar patterns are found in children and adolescents as reported in adults. Most studies in children reported higher levels of pain catastrophizing in girls compared to boys (see e.g Bédard et al., 1997; Crombez et al., 2003; Hermann et al., 2007). Similarly, self-reports of pain and other types of pain expression are higher in girls as compared to boys (Guinsberg et al., 2000; Keogh & Eccleston, 2006; Unruh & Campbell, 1999) Here, pain catastrophizing has also been found to mediate the relationship between gender and self-reports of pain (Keogh & Eccleston, 2006).

Observed gender differences in catastrophizing, pain-reports, pain expression and the importance of catastrophizing in accounting for these differences have contributed to theorizing catastrophizing not solely as an intrapersonal construct, but also as a construct that needs to be understood in light of the social environment in which catastrophizing emerges.

THEORETICAL APPROACHES TO PAIN CATASTROPHIZING

Several theoretical models have been introduced suggesting several hypothesized mechanisms of actions (Edwards, Bingham, Bathon, & Haythornthwaite, 2006; Sullivan et al., 2001). Most often, processes related to the individuals' *appraisals* of pain and associated heightened *attention* to pain have been invoked to understand how catastrophizing impacts upon pain (see e.g., Crombez, Eccleston, Baeyens & Eelen, 1998; Eccleston & Crombez, 1999; Lazarus & Folkman, 1984; Sullivan, Rouse, Bishop, & Johnston, 1997). Recently, also processes related to *social-behavioural* dimensions of catastrophizing have been invoked to understand how catastrophizing might impact upon deleterious pain outcomes; i.e. via its impact upon the social environment (see e.g., Boothby, Thorn, Overduin, & Ward, 2004; Keefe, Lumley, Anderson, Lynch, & Carson, 2001; Sullivan et al., 2001). As such, two main routes can be distinguished through which catastrophizing contributes to negative pain outcomes. A first route can be understood as an *intra*personal route to negative pain outcomes, the second route reflects an *inter*personal route to pain.

Theoretical approaches highlighting intrapersonal and interpersonal routes to pain are not necessarily incompatible. Catastrophizing may simultaneously exacerbate pain outcomes through its effect upon their own as well as other's way of responding to their pain (Sullivan et al., 2001). Hence, differential routes might be complementary, and, as we will argue below, might have the same underlying roots.

Intrapersonal perspective on pain catastrophizing

Catastrophic thinking about pain has been considered as an *appraisal* within the transactional stress and coping model of Lazarus and Folkman (1984). According to Lazarus & Folkman (1984), appraisal can be understood as an evaluative process. A distinction is made between primary appraisals and secondary appraisals. Primary appraisals involve evaluating a potential stressor or particular event as irrelevant, benign-positive, or stressful. Secondary appraisals involve evaluating a particular stressor with coping options and their possible effictiveness. The different components of catastrophizing, as defined within the Pain Catastrophizing Scale (PCS; Sullivan et al., 1995) share features with primary and secondary appraisal processes. Specifically, rumination and magnification may reflect an exagerrate focus on and evaluation of painful stimuli as threatening (primary appraisals), whereas helplessness is related to appraisals of painful stimuli as unable to cope with (Lazarus & Folkman, 1984; Severeijns, Vlaeyen, & Van den Hout, 2004; Sullivan et al., 2001).

Threat related appraisals of pain may install a hypervigilance for pain. The role of *attentional* factors in catastrophizing has been noted by several investigators (Crombez et al., 1998; Crombez, Van Damme & Eccleston, 2005; Eccleston & Crombez, 2005). Supportive evidence exists that pain catastrophizing is related to excessive appraisals of threat and to attentional interference. For example, high catastrophizers experience more difficulty suppressing or diverting attention away from pain (Crombez et al., 2002; Sullivan et al., 1995:

Van Damme, Crombez, & Eccleston, 2004). Heyneman, Fremouw, Gano, Kirkland, & Heiden (1990) reported experimental evidence suggesting that high catastrophizers are impaired in their ability to use distraction techniques. A persistent heightened focus upon threatening stimuli may screen out cognitive processing of other thoughts, so that distraction or problem-solving coping behaviours are not operative in these invididuals (Bédard et al., 1997; Crombez et al., 1998; Heyneman et al., 1990; Lynch, Kashikar-Zuck, Goldschneider, & Jones, 2007; Sullivan et al., 1995).

In normal situations, appraising pain as threatening may serve an adaptive function; it may function to maintain vigilance to unresolved threat and to maintain an engagement in finding a solution to the threatening problem, for instance by facilitating avoidance and escape from pain (Crombez et al., 2003; Eccleston & Crombez, 2007). Catastrophizing may perhaps become most problematic in situations where pain is chronic and insoluble. Here, catastrophizing may become a perseverative and ineffective strategy that fuels distress and hypervigilance to pain (De Vlieger, Van den Bussche, Eccleston, & Crombez, 2006; Eccleston & Crombez, 1999; Eccleston & Crombez, 2007; Suls & Fletcher, 1985). Specifically, escape and avoidance behaviours have the immediate consequences that daily activities (expected to increase pain) are not accomplished anymore, thereby resulting in increased disability. In addition, since avoidance behaviours occur in anticipation of pain rather than in response to it, these behaviours are more likely to persist because there are fewer opportunities to correct the wrongful expectancies about pain as a signal of threat. Longstanding avoidance and physical inactivity is known to detrimentally affect various physiological systems thereby contributing to heightened pain experience (Crombez, Vlaeyen, Heuts, & Lysens, 1999; Vlaeyen & Linton, 2000).

Interpersonal perspective on pain catastrophizing

Central to understanding both the intrapersonal and interpersonal adaptive features of pain is the recognition that pain serves as an archetypal sign of threat and demands attention not only from the sufferer, but also, through behavioural manifestations, the attention and potentially the concern of others in the social environment (Hadjistavropolous & Craig, 2002; Craig, 2004; Goubert et al., 2005). As catastrophizing is an instantiation of the high threat value of pain, it follows that those who amplify the threat value of pain may enhance these processes.

Drawing from research indicating (1) women engage in higher levels of catastrophizing as compared to men (Crombez et al., 2003; Hermann et al., 2007; Keefe et al., 2000; Sullivan et al., 1995), (2) women are more socially-oriented and more expressive in dealing with their pain (Keogh & Eccleston, 2006; Keogh & Herdenfeldt, 2002; Tamres, Janicki, & Helgeson, 2002; Unruh, 1996) and (3) that catastrophizing about pain is important in explaining significant differences between men and women's pain experience and related behaviour (Keefe et al., 2000; Keogh & Eccleston, 2006; Sullivan et al., 2000), Sullivan et al. (2001) suggested catastrophizing is related *primarily* to a communal and emotionally expressive orientation toward dealing with pain and distress situations. The authors emphasize the importance of

looking beyond the immediate instrumental value of pain behaviour and recognize the communicative adaptive function or adaptive orientation in those individuals who catastrophize about pain; i.e. through heightened display of distress and communicating an inability to deal effectively with a painful situation, individuals who catastrophize may be maximizing the probability that potential caregivers will maintain proximity or offer support or assistance (Sullivan et al., 2000; 2001).

The ability to solicit support from others in the social environment may indeed have stress-, pain- or fear reducing properties and hence, serve protective social functions (Craig, 2004; Prkachin & Craig, 1995). Facial expressions of pain may be particularly salient in this regard (Hadjistavropolous, Craig, Grunau, & Whitfield, 1997, Poole & Craig, 1992; Williams, 2002). However, the ensuing development of a catastrophic cognitive style may, particularly over time, increase the aversive nature of subsequent pain experiences (Boothby et al., 2004; Buenaver, Edwards, & Haythornthwaite, 2007; Cano, 2004; Sullivan et al., 2001). First, others' responses to heightened pain expression may detrimentally affect catastrophizing and associated pain outcomes, for instance by positively reinforcing catastrophizing and related behaviour (Sullivan et al., 2001). Hence, operant principles might come into play and serve to trigger or maintain catastrophic thinking about pain. In these circumstances, presence of solicitous others or persons from whom distress relieving responses are more likely (e.g., parent, spouse), may act as a discriminative cue for the display of pain in high catastrophizing individuals (Sullivan et al., 2001). Second, catastrophizers' high and persistent demand upon other's responses may also give rise to heightened levels of caregivers' distress (Cano, Leonard, & Franz, 2005; Keefe et al., 2003), tax interpersonal relationships (Lackner & Gurtman, 2004) and eventually lead to negative responses such as critical or punishing responses (Boothby et al., 2004: Buenaver et al., 2004).

The communicative or social function of catastrophizing is supported by a diverse range of findings in adult samples. Specifically, the aforementioned findings on the relationship between catastrophizing and pain behaviours might be interpreted in this light; high catastrophizing individuals express more pain compared to low catastrophizing individuals (Keefe et al., 2003; Sullivan et al., 2000; Sullivan, Martel, Savard, & Crombez, 2006b). Recent findings have indicated this is particularly true when in presence of another person as compared to when they are alone (Sullivan, Adams, & Sullivan, 2004). Catastrophizer's heightened pain expression and difficulty in dealing with pain is also perceived as such by others. For example, Sullivan et al. (2006b) showed that catastrophizer's heightened pain display lead observers to infer more pain. In addition, Keefe et al. (1997) showed that high catastrophizing adult patients with osteoarthritis were perceived by their spouse as being less able to effectively manage their pain compared to patients who scored low on the measure of catastrophizing. Researchers have also observed positive associations between catastrophizing and solicitous responses (Cano, 2004; Giardino, Jensen, Turner, Ehde, & Cardenas, 2003; Keefe et al., 1997). For example, Keefe et al. (1997) showed that high catastrophizing cancer patients reported receiving more instrumental support from caregivers. Similarly, Cano (2004) reported pain catastrophizing was related to

more perceived solicitous responses. Findings indicating the relationship between catastrophizing and pain is higher for those who report higher levels of partner solicitousness and for those who life with a spouse or partner than for those who live alone (Giardino et al., 2003) further suggest catastrophizing may exert its impact upon pain outcomes via its effect upon the social environment. Catastrophizing, however, appears to elicit a wide diversity of social responses, including not only positive or solicitous responses but also negative ones such as critical or punishing responses (Boothby et al., 2004; Buenaver et al., 2007; Cano, 2004). The latter may possibly further add to the aversiveness of catastrophizer's pain experience (Buenaver et al., 2007; McCracken , 2005).

With the exception of findings indicating high catastrophizing in children is associated with higher levels of social support seeking (Bédard et al., 1997; Eccleston et al., 2004) and more health care use (Gil et al., 1993), there are no studies that have addressed communicative dimensions of pain catastrophizing in children and adolescents.

AIM

Considerable research in adults has indicated pain catastrophizing is of importance in understanding adjustment to pain (Sullivan et al., 1995; Sullivan et al., 2001). Research is emerging indicating catastrophizing may also constitute a risk factor for deleterious pain outcomes in pediatric populations (Crombez et al., 2003; Hermann et al., 2007; Lynch et al., 2006). No findings, however, are available on the prospective and/or the distinctive role of catastrophizing in children and adolescents with regard to related constructs such as e.g negative affectivity (Brown, O'Keeffe, Sanders, & Baker, 1986). In addition, recent studies in adults indicate catastrophizing might be understood in a context of seeking or demanding help, and hence, be an important factor in understanding interpersonal features of pain (Sullivan et al., 2001; Keefe et al., 2003). To date, no studies have investigated communicative dimensions of pain catastrophizing in children and adolescents. The role of pain catastrophizing in pain expression, however, might be of particular importance in children. Children are highly dependent upon adult, and in particular parents who carry the primary responsibility to care and socialize their children. They are often present when their child experiences pain, and may thus fundamentally affect how the child experiences pain and how the child copes with the current pain but also future pain (Craig et al., 2006; McMurtry, McGrath, & Chambers, 2006; Palermo and Chambers, 2005; Chambers, 2003; Walker et al., 2006).

This dissertation has two central research objectives. A first objective constitutes examination of the extent to which catastrophizing contributes to deleterious pain outcomes in children and adolescents. Specifically, the conceptual distinctiveness and predictive value of catastrophizing in relation to negative affectivity was addressed, cross-sectionally and prospectively (*Part I*). A second objective constitutes examination of pain catastrophizing from within an interpersonal perspective. Specifically, we investigated, using different samples and methodologies, whether pain catastrophizing contributes to heightened pain expression (*Part II*).

Investigating both objectives are not only of theoretical but also of clinical interest. First, disentangling the influence of pain catastrophizing from closely related constructs such as negative affectivity may offer a more precise view on the relative importance of these constructs within treatment. Second, to the extent that pain catastrophizing becomes manifest socially through pain expressive behaviours, treatment might also address the social networks of those children who highly catastrophize about pain.

Part I of this dissertation is compiled of 2 chapters. In Chapter 1, data is presented on two cross-sectional studies; one in a sample of school children and a second in a sample of children with chronic or recurrent pain. Using questionnaires, we investigated the effect of the child's catastrophizing upon their reports of pain, disability and somatic complaints, beyond the effect accounted for by the child's negative affectivity (NA). Mediational effects of the child's catastrophizing for the relationship between the child's NA and the outcome measures were also examined. **Chapter 2** proceeds on the results of chapter 1 as a prospective study in schoolchildren in which we investigated the impact of pain catastrophizing and the moderating role of child's initial (baseline) pain intensity level in predicting pain and disability outcomes 6 months later, beyond the effects of negative affectivity. We examined whether negative affectivity at baseline is a precursor for catastrophizing: i.e. whether NA predicts the child's level of catastrophizing at follow-up.

Part II of this dissertation is compiled of 4 chapters. **Chapter 3** reports on findings of a cross-sectional study in a sample comprising of school children, children with chronic or recurrent pain, and their parents. Using questionnaires, we investigated the impact of the child's pain catastrophizing (1) upon their tendency to verbally share their pain experience with others and (2) upon parental perceptions of different types of pain behaviour in their child (i.e. non-verbal and verbal communicative pain behaviours and protective behaviours). In addition, significant differences between the school children and children with chronic or recurrent pain were investigated and discussed. **Chapter 4** presents findings of an observational study in a sample of adolescents with chronic pain who performed a 2 minute walk test. We investigated associations between the adolescents' level of catastrophizing and the extent to which they engaged in different types of pain behaviours, i.e. communicative pain behaviours (facial pain expressions and verbalizations) and protective pain behaviours. In **Chapter 5** findings are presented of an observational study in which schoolchildren experienced cold pressor pain whilst being observed by their parent. In this study, we investigated the effect of the child's pain catastrophizing and self-reported pain upon the child's facial expression of pain and parental ratings of the child's pain. **Chapter 6** reports on an experimental study in schoolchildren. This experiment investigated the effects of child catastrophic thinking and parental presence upon the facial expressions of children when experiencing pain. School children experienced pressure pain in either one of two conditions: (1) when observed by their parent or (2) when observed by an adult stranger.

The main findings of the different studies are critically appraised and summarized in a **general discussion**. This closing chapter discusses theoretical and clinical implications and addresses limitations of our studies and recommendations for future research.

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PART I

PAIN CATASTROPHIZING AND PAIN OUTCOMES IN CHILDREN AND ADOLESCENTS

CHAPTER 1

CATASTROPHIC THINKING ABOUT PAIN IS INDEPENDENTLY ASSOCIATED WITH PAIN SEVERITY, DISABILITY, AND SOMATIC COMPLAINTS IN SCHOOL CHILDREN AND CHILDREN WITH CHRONIC PAIN[1]

ABSTRACT

This study investigated the value of pain catastrophizing in explaining pain, disability and somatic complaints, beyond negative affectivity. Two cross-sectional studies, one in a sample of school children (n = 193) and a second in a clinical sample of children with recurrent or chronic pain (n = 43), were conducted. In both studies, measures of pain catastrophizing and negative affectivity were examined for their ability to explain pain, disability, and somatic complaints. In both studies, pain catastrophizing significantly accounted for the variance of pain, disability and somatic complaints, beyond the effects of age, sex, and negative affectivity. Furthermore, pain catastrophizing significantly mediated the relationship between negative affectivity and somatic complaints in both studies, and between negative affectivity and functional disability Study 1. Results suggest the importance of assessing for pain catastrophizing in children. Pain catastrophizing is further discussed in terms of communicating distress to significant others.

[1] Vervoort, T., Goubert, L., Eccleston, C., Bijttebier, P., & Crombez, G. (2006). Catastrophic thinking about pain is independently associated with pain severity, disability, and somatic complaints in school children and children with chronic pain. *Journal of Pediatric Psychology, 31*, 674-683.

INTRODUCTION

There are many opportunities in childhood to learn that pain is aversive, associated with danger, and largely to be avoided. It is a common experience: children have, on average, an episode of pain every three waking hours (Fearon, McGrath, & Achat, 1996). Children can also experience a diversity of somatic events, including headache, dizziness, and fatigue (Garber, Walker, & Zeman, 1991). Fortunately, when complaints are graded for their severity and impact upon daily living, most episodes appear to be neither severe nor disabling (Garber et al., 1991).

Intrinsic to the experience of pain is its threat value (Eccleston & Crombez, 1999). In the context of pain-as-threat, it has been established that the anticipation and fear of pain can develop (Crombez, Vlaeyen, Heuts, & Lysens, 1999; Vlaeyen & Linton, 2000). The specific character and frequency of 'pain-related fear' have been studied as potentially important processes in explaining pain, disability, and emotional distress (Sullivan et al., 2001b; Vlaeyen & Linton, 2000). Especially important in explaining pain and disability is the extent to which one makes exaggerated and fearful appraisals of pain and its consequences, commonly known as 'catastrophic thinking about pain' (Sullivan et al, 2001b).

Complementing the rich seam of theoretical and empirical work that can inform our understanding of childhood pain, the concepts of *fear of pain* and *catastrophic thinking about pain* are ones that have already received a great deal of attention in the adult literature (Sullivan et al., 2001b; Vlaeyen & Linton, 2000). Considerable research has shown that catastrophizing in adults contributes to more intense pain, disability, and emotional distress (Sullivan et al., 2001a). Furthermore, catastrophizing in adults has been associated with the overprediction of pain (Goubert, Crombez, & Van Damme, 2004), greater difficulty disengaging attention from pain (Van Damme, Crombez & Eccleston, 2002), increased pain behavior, increased use of health care services and medication, and longer hospital stays (Sullivan et al., 2001b).

Although the number of studies of catastrophic thinking about pain in children is small, the results are promising and quite congruent with those of the adult literature. Greater pain catastrophizing in children is related to more pain severity and disability (Crombez et al., 2003), lower pain tolerance (Piira, Taplin, Goodenough, & von Baeyer, 2002), more anxiety and depression (Eccleston, Crombez, Scotford, Clinch, & Connell, 2004), and increased analgesic use (Bédard, Reid, McGrath, & Chambers, 1997).

Some writers have argued that a focus on specific patterns of anxious thinking, such as pain catastrophizing, may underestimate the role of stable individual differences (Watson & Pennebaker, 1989). Previous research findings have revealed that negative affectivity (NA), which can be described as the stable disposition to experience negative and distressing emotions, may underlie the commonly observed associations between specific patterns of anxious thinking and self-reported health complaints, both in adults (Watson & Pennebaker, 1989) and in children (Walker, Garber, Smith, Van Slyke, & Claar, 2001). Watson and Pennebaker (1989) argued that the relationship between NA and somatic complaining is best explained by a hypervigilance in persons with high levels of NA: "First, NAs may be more

likely to notice and attend to normal body sensations and minor aches and pains. Second, because their scanning is fraught with anxiety and uncertainty, high NAs may interpret normal symptoms as painful or pathological" (p. 247).

It is therefore likely that people with high levels of NA are more inclined to notice and catastrophize about a diversity of minor aches and pains, but that the effect of NA disappears when somatic sensations become intense and highly salient for everyone (see, for example, Goubert et al., 2004).

To what extent catastrophic thinking about pain is one particular instantiation of the general disposition to experience negative affect, is unclear. Several studies with children suggest that NA may indeed underlie some of the effects of pain catastrophizing: There is an association between NA and self-report measures of health in children and adolescents (Ondersma, Lumley, Corlis, & Tojek, 1997), and adolescents with chronic pain report more NA than adolescents without chronic pain (Merlijn et al., 2003). Attempts to disentangle the effects of catastrophizing about pain and NA are of both theoretical and clinical interest. NA and pain catastrophizing appear to develop early in life (Sullivan et al., 2001b) and are often maintained throughout the life-span (Brown, O'Keeffe, Sanders, & Baker, 1986). However, pain catastrophizing is more context-dependent and less stable than personality traits, and is therefore more malleable (Sullivan, Bishop, & Pivik, 1995; Sullivan et al., 2001b).

The primary focus of the present article is to disentangle the effects of catastrophic thinking about pain and the effects of NA in accounting for children's somatic complaints, pain severity, and disability. We report two cross-sectional studies of children: one involving a sample of school children and the other involving a clinical sample of children with chronic or recurrent pain. In presenting the results of these studies, we first report correlations between both NA and pain catastrophizing and the three outcome measures. We then consider whether individuals high in NA tend to report less severe somatic complaints. Because conclusions about the health correlates of NA are often based upon outcome measures that combine the number and the severity of complaints, we explored whether NA correlated significantly with individual indexes of the number and/or severity of reported symptoms. Finally, in a series of multiple regression analyses, we investigated the unique role of pain catastrophizing in accounting for somatic complaints, functional disability and pain severity, beyond the effect of NA. In cases in which the conditions for mediation (see e.g., Holmbeck, 2002) were met, we then tested whether pain catastrophizing mediated the relationship between NA and the three outcome measures.

STUDY 1

METHOD

Participants

Following approval from the Ghent University Faculty of Psychology and Educational Sciences ethics committee, four Flemish schools in grades 4 through 6 were contacted. All schools agreed to participate. A total of 193 children (89 boys, 104 girls; mean age = 11.1 yrs, *SD* = 0.9, age range from 9 years to 13.3 years) were recruited. All children in grades 4 through 6 were approached, and agreed to participate in the study. Twenty-three percent of the children (*n* = 44) were recruited from the fourth grade, 25% (*n* = 48) from the fifth grade, and 52% (*n* = 101) from the sixth grade. The final sample for which complete data were available consisted of 174 children: invalid composite scores (more than 25% of the items of a given questionnaire not answered; *n* = 19) were coded as missing values.

Instruments

Somatic complaints were assessed with the Dutch version of the *Children's Somatization Inventory* (*CSI*; Bijttebier, Ceuppens, & Keuleers, 2001; Walker & Greene, 1989). The CSI assesses the extent and frequency of 35 somatic complaints (e.g., headaches, constipation, memory loss) that children have experienced during the past two weeks. The children rate each of the items on a 5 point-scale (0='not at all', 4='a whole lot'). Total scores can range from 0 to 140. The CSI has shown to be a reliable and valid instrument in previous research (Garber et al., 1991; Meesters, Muris, Ghys, Reumerman, & Rooijmans, 2003).

Pain-related disability was assessed with the Dutch version of the *Functional Disability Inventory* (*FDI*; Crombez et al., 2003; Walker & Greene, 1991). The FDI is a self-report inventory for children that measures perceived difficulty in performing a number of activities in the domains of school, home, recreation, and social interactions. It consists of 15 items to be rated on a 5-point scale (0 to 4), and yields total scores that can range from 0 to 60. The reliability and validity of the FDI has been demonstrated in research by Walker and Greene (1989).

Catastrophic thinking about pain was assessed with the Dutch version of the *Pain Catastrophizing Scale for Children* (*PCS-C*; Crombez et al., 2003). This instrument is an adaptation of the adult Pain Catastrophizing Scale (Sullivan et al., 1995). The PCS-C consists of 13 items describing different thoughts and feelings that children may experience when they are in pain. Children rate how frequently they experience each of the thoughts and feelings when they are in pain using a 5-point scale (0 ='not at all', 4 ='extremely'). The PCS-C yields a total score that can range from 0 to 52, and three subscale scores for rumination, magnification and

helplessness. The PCS-C has shown to be a reliable and valid instrument in children from 9 to 15 years (see Crombez et al., 2003).

Pain severity was assessed by two *Visual Analogue Scales* (*VAS*). Children rated their 'most severe pain' in the past three weeks and their 'present pain severity' on a 10 cm VAS with the end points 'no pain' and 'a lot of pain'. The pain severity VAS has a good reliability and validity in children 9 to 15 years old (McGrath, 1987). As the various forms of the VAS are usually correlated (Johnston, 1998), we calculated the mean score of 'present pain intensity' and 'most severe pain' as an index of pain severity.

NA was assessed using the emotional instability subscale of the *Hierarchical Personality Inventory for Children* (*HiPIC*; Mervielde & De Fruyt, 1997; 1999). The HiPIC is a 144-item questionnaire measuring five broad personality factors (extraversion, conscientiousness, emotional instability, imagination. and benevolence-agreeableness) in children from 6 to 12 years. The emotional instability scale contains 2 subscales, self-confidence (reversed scored) and anxiety/depression, and consists of 16 items. Participants rate the degree to which each item is characteristic for them on a 5-point scale (1='not at all', 5='very much'). Total scores can range from 16 to 80 with higher scores indicating higher emotional instability.

To avoid ambiguity, the label *negative affectivity* will be used instead of emotional instability when referring to this measure. This relabelling is justified. First, the content of the HiPIC items closely resembles with those of other NA measures. Second, studies investigating the construct validity of the HiPIC, have revealed that both the emotional instability scales of the HiPIC and the N(euroticism)-facets of the NEO PI-R load highly on the same factor in adolescents. (Costa & McCrae, 1992; De Fruyt, Mervielde, Hoekstra, & Rolland, 2000). The HiPIC has been shown to have good reliability and validity (De Fruyt et al., 2000).

Procedure

Four schools were contacted by two research assistants. All four schools agreed to take part in the study. Teachers and parents received a letter in which the purpose of the study was explained. Written informed parental consent, and child assent, were obtained. The set of questionnaires described above was administered to the children during their regular school hours.

RESULTS

Descriptive statistics

Overall, the frequency of somatic complaints on the CSI was low (M = 16.13, SD = 14.37), comparable with findings of Meesters et al. (2003) in a community sample of adolescents. The five most frequent symptoms (items endorsed 'a lot' or 'a whole lot') were headaches (19.2%),

stomach pain (11.9 %), pain in limbs (9.8 %), sore muscles (9.3 %), and nausea/upset stomach (7.8 %). 54.9% of the children reported at least one severe physical symptom.

Children reported low to moderate levels of pain severity on the VAS. The mean ratings were 20.16 (*SD* = 24.78) for the present pain level, and 48.82 (*SD* = 27.88) for the highest pain level. 90.6 % of the children reported at least one pain experience in the past three weeks. However, 82.4 % of them reported that the pain was very little to moderate. Only 3.8 % of the children reported constant pain. These findings are in line with ones obtained previously (e.g., Perquin et al., 2000) and indicate that pain is a common experience and complaint in childhood and adolescence.

There were low levels of functional disability in this sample (*M* = 8.18, *SD* = 7.82), compared to findings in clinical pediatric pain patients (Crombez et al., 2003; Kashikar-Zuck, Goldschneider, Powers, Vaught, & Hershey, 2001). The mean level of catastrophic thinking about pain (*M* = 13.27, *SD* = 8.72) was similar to those of Crombez et al. (2003). The mean NA was 42.55 (*SD* = 9.37), similar to the normative mean scores for children aged 6 to 12 years (Mervielde, & De Fruyt, 1997).

Correlations

Mean scores, standard deviations, Cronbach's α coefficients and Pearson intercorrelations for pain catastrophizing, pain severity, somatic symptoms, functional disability and NA are presented in Table 1. As expected, the positive correlation between pain catastrophizing and NA was significant. Statistically significant positive associations were also found for pain catastrophizing with pain severity, somatic complaints, and pain-related disability. By comparison, NA was significantly and positively related to somatic complaints and functional disability, but not with pain severity.

Further analyses were performed to examine whether NA correlated with the number and/or mean severity ratings of symptoms/disability reported. Separate indexes were computed for the number of somatic complaints and functional disabilities reported (i.e. the number of symptoms/disabilities that children reported as having been present), and for the mean severity ratings (i.e. the total score on the CSI, respectively FDI divided by the number of somatic complaints, respectively functional disability reported). The correlation analyses revealed that NA was significantly correlated with the number of somatic symptoms reported (r = .24, $p < .001$), but not with the mean severity ratings of somatic symptoms (r = .10, ns). Similarly, NA was correlated significantly with the number of functional disabilities (r = .22, $p < .01$), but not with the mean severity of the disability ratings (r = .-.07, ns).

Table 1

Means (M), Standard deviations (SD), Cronbach's α, and Pearson intercorrelations of pain catastrophizing, pain severity, somatic complaints, functional disability and negative affectivity (HiPIC-emotional instability scale) in a sample of school children (M, SD, α printed normal, correlation coefficients above the diagonal) and in a clinical sample (M, SD, α printed in italics, correlation coefficients below the diagonal).

	STUDY 1		STUDY 2						
	M (*SD*)	*α*	*M* (*SD*)	*α*	1	2	3	4	5
1. Pain catastrophizing	13.27 (8.72)	.89	21.88 (11.44)	.90	---	.38***	.66***	.49***	.36***
2. Pain severity	34.49 (22.57)	.63	65.43 (21.39)	.52	.49**	---	.52***	.33***	.11
3. Somatic complaints	16.13 (14.37)	.90	26.35 (16.73)	.88	.55**	.45**	---	.64***	.21*
4.Functional disability	8.18 (7.82)	.86	21.21 (11.30)	.88	.50**	.57***	.44**	---	.16*
5. Negative affectivity	42.55 (9.37)	.61	33.99 (7.86)	.88	.57***	-.04	.35**	.24	---

* p < .05; ** p < .01; *** p < .001

The predictive value of negative affectivity and pain catastrophizing

Next, three hierarchical regression analyses were conducted to examine the contribution of NA and pain catastrophizing in explaining somatic complaints, pain severity and disability. In each analysis, sex (boys coded as 0, girls coded as 1) and age were entered in step 1 to control for the possible effects of these sociodemographic variables. NA was entered in step 2, and. pain catastrophizing was entered in step 3. The results of these analyses are reported in Table 2.

The regression analysis with *somatic complaints* as the dependent variable revealed that NA ($F_{Change}(1,169) = 7.10$, $p<.01$, $\Delta R^2 = .04$) and pain catastrophizing ($F_{Change}(1,168) = 116.00$, $p<.0001$, $\Delta R^2 = .38$) were both significant predictors. The analysis with *pain severity* as the dependent variable revealed that NA was not a significant predictor ($F_{Change}(1,169) = 1.62$, $\Delta R^2 = .01$, ns). Pain catastrophizing, however, had a unique contribution in explaining pain severity, beyond age, sex and NA ($F_{Change}(1,168) = 26.13$, $p <.0001$, $\Delta R^2 = .13$). Finally, a regression analysis with *functional disability* as the dependent variable was performed. Both NA ($F_{Change}(1,169) = 5.38$, $\Delta R^2 = .03$, $p < .05$) and pain catastrophizing ($F_{Change}(1,168) = 52.64$, $p <.0001$, $\Delta R^2 = .23$) emerged as significant predictors in this analysis.

The variance-inflation factors of all three regression analyses were acceptable (range 1.05 – 1.20), suggesting that there was no problem of multicollinearity. The contribution of the three individual subscales of the PCS-C could not be examined, however, as the variance-inflation factors (VIF > 2) did present problems for this regression analysis.

Table 2

Prediction of somatic complaints, pain severity and disability in a sample of school children and in a clinical sample: results of hierarchical regression analyses. Standardized betas of the last step in the analysis are displayed.

			STUDY 1			STUDY 2		
Criterion Variable	Step	Predictor	*β*	*ΔR²*	*Adj. R²*	*B*	*ΔR²*	*Adj. R²*
Somatic complaints	1	Age	-.12	.04	.03	.01	.02	-.03
		Sex	-.13*			.04		
	2	Negative affectivity[1]	.02	.04*	.06	.04	.12*	.07
	3	Pain catastrophizing	.67***	.38***	.44	.54**	.19**	.25
Pain severity	1	Age	-.11	.02	.01	.14	.08	.03
		Sex	-.09			.05		
	2	Negative affectivity[1]	-.01	.01	.02	-.44*	.00	.00
	3	Pain catastrophizing	.40***	.13***	.14	.68***	.30***	.31
Functional disability	1	Age	-.01	-.00	-.01	.40**	.27**	.23
		Sex	-.17*			.18		
	2	Negative affectivity[1]	.04	.03*	.02	.02	.06	.26
	3	Pain catastrophizing	.53***	.23***	.25	.40*	.11*	.36

*p < .05; ** p < .01; *** p < .0001

[1] (HiPIC- emotional instability scale for sample of school children, STAIC-T for clinical sample)

Mediation analyses

To test for mediation, the following conditions should be met: (1) a significant association between the predictor and the outcome variable (path a in Figure 1 and 2), (2) a significant association between the predictor and the mediator (path b in Figure 1 and 2), and (3) a significant association between the mediator and the outcome variable, after controlling for the effect of the predictor (path c in Figure 1 and 2). If all of these conditions are met, one then examines whether the impact of the predictor on the outcome is significantly reduced after controlling for the putative mediating variable (Holmbeck, 2002). Sobel's significance test was used to determine whether the predictor → outcome effect is significantly reduced upon introduction of the putative mediator. The percentage of the total effect that was mediated was also computed. The conditions for conducting a mediation analysis were met for the outcome measures of somatic complaints and functional disability, but not for the measure of pain severity.

First, we investigated whether pain catastrophizing mediated the relationship between NA and somatic complaints. The tested model is illustrated in Figure 1. Mediation analyses revealed a Sobel *z*-score = 3.65, p < .0005, indicating significant mediation. Pain catastrophizing accounted for 92.57 % of the relationship between NA and somatic complaints.

In a second mediation analysis, we investigated whether pain catastrophizing mediated the relationship between NA and functional disability. The tested model is illustrated in Figure 2. Mediation analyses revealed a Sobel *z*-score = 3.45, p < .0005, indicating significant mediation. Pain catastrophizing accounted for 82.39 % of the relationship between NA and functional disability.

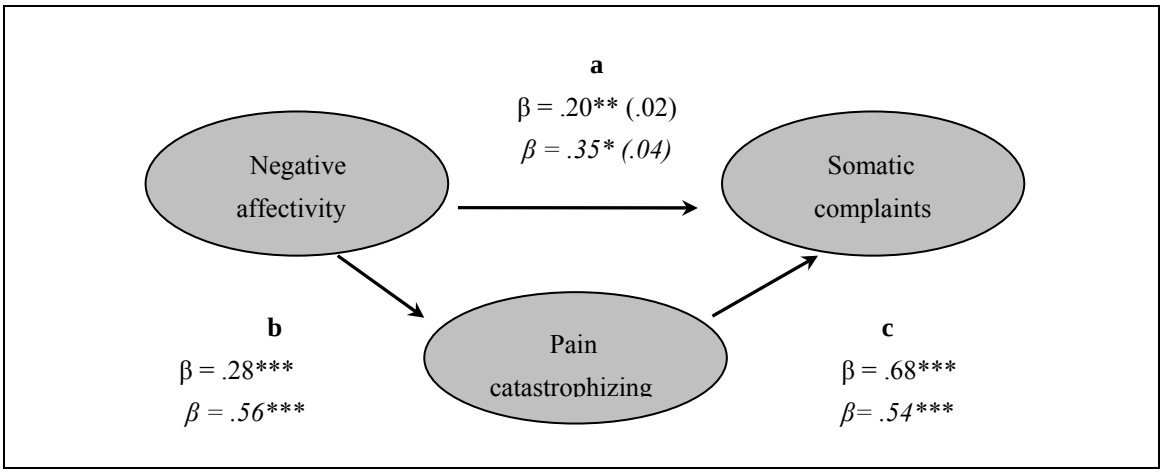

Figure 1. *Pain catastrophizing mediates the relationship between NA and somatic symptoms in a sample of school children and in a clinical sample (printed in italics). Standardized Betas are shown. The standardized Beta between brackets refers to the direct effect of NA on the outcome measures when controlling for catastrophizing.*

*p < .05; ** p < .01 *** p < .0001

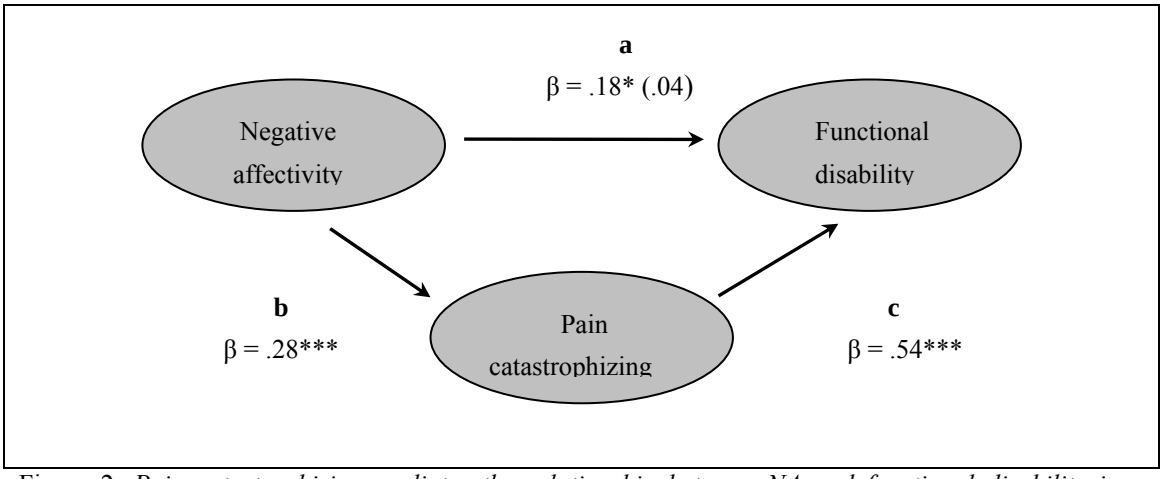

Figure 2. *Pain catastrophizing mediates the relationship between NA and functional disability in a sample of school children. Standardized Betas are shown. The standardized Beta between brackets refers to the direct effect of NA on functional disability when controlling for catastrophizing.*

*p < .05;*** p < .0001

DISCUSSION

In a large sample of school children, we found that the experience of somatic symptoms, pain, and its impact upon daily functioning, are in line with the results of previous studies (see e.g.,, Meesters et al., 2003; Perquin et al., 2000). The results reveal that pain is a common somatic experience in children. In fact, the most frequently occurring somatic complaints were pain complaints: headache, stomach pain, pain in joints, followed by sore muscles and nausea/upset stomach. We also found that catastrophizing about pain was positively related to somatic complaints, pain severity, and functional disability, and that the stable disposition to experience negative affect was related to somatic complaints, functional disability, and pain catastrophizing. However, further analyses indicated that children scoring high on NA tend to report a greater diversity of somatic complaints and functional disability, but not necessarily a greater severity.

Of interest in this study was the specific role of pain catastrophizing and NA in predicting somatic complaints, pain severity, and disability. Despite the fact that pain catastrophizing and NA were significantly associated, the predictive value of pain catastrophizing cannot be accounted for in terms of its overlap with the effect of NA. Pain catastrophizing had a unique and important role in explaining somatic complaints, pain severity, and disability beyond NA. Moreover, pain catastrophizing mediated the relationship between NA and both somatic complaints and functional disability.

The main objective of Study 2 was to explore further the role of pain catastrophizing and NA. As the results of Study 1 may not generalize to samples other than school children, we decided to use a clinical sample of children with chronic or recurrent pain.

STUDY 2

METHOD

Participants

The participants in Study 2 were drawn from the clinical sample of Crombez et al. (2003). The results of Study 2 are secondary analyses of these data. Forty-three children with recurrent or chronic pain (23 girls, 20 boys; mean age = 11.8 years, *SD* = 2.14; range: 8.25 years to 16.5 years) were recruited from a pediatric ward setting in the University Hospital of Leuven on a consecutive basis. Approval was obtained in accordance with institution review board requirements. Participants were hospitalized at the pediatric ward. As part of a standard assessment procedure for pediatric patients, they were referred to the child psychiatric unit for psychological evaluation of their pain complaints.

The mean duration of the pain complaints was 34.98 months (*SD* = 35.31, range 2-120). The most frequent pain complaints were abdominal pain (*n* = 18, 41.9%) and headaches (*n* = 14,

32.6%). Less frequent pain complaints were joint pain (n = 4, 9.3%), low back pain (n = 3, 7.0%), pain in the legs (n = 2, 4.7%) and pain in the hip (n = 2, 4.7%). The mean level of global functioning, as assessed by the DSM-IV Axis V rating by a psychiatrist, was 57.46 (SD = 12.27) at the time of the study and 72.88 (SD = 13.09) for the past year. The mean number of past hospitalisations was 4.21 (SD = 3.96), the mean number of outpatient visits was 15.40 (SD = 15.04). All participants who were approached agreed to participate in the study.

The final sample for which complete data were available consisted of 38 children: invalid composite scores (more then 25% of the items of a given questionnaire not answered; n = 5) were coded as missing values.

Instruments

Somatic complaints, functional disability. and pain catastrophizing were assessed by, respectively, the *Children's Somatization Inventory (CSI),* the *Functional Disability Inventory (FDI),* and the *Pain Catastrophizing Scale for Children (PCS-C)*. A description of these instruments can be found in the method section of Study 1.

Pain severity was assessed on a 0- to 10 cm Visual Analogue Scale (VAS; 0 = 'no pain', 10 = 'a lot of pain'. The participants were asked to rate their 'average' and 'highest' pain severity in the past two weeks. As in Study 1, the mean score of 'average pain intensity' and 'highest pain intensity' was calculated as an index of pain severity.

Negative affectivity was assessed by the Trait version of the Dutch version *State-Trait Anxiety Inventory for Children* (*STAIC-trait;* Bakker, Van Wieringen, Van der Ploeg, & Spielberger, 1989; Spielberger, Edwards, Lushene, Montuori, & Platzek, 1973). Measures of trait anxiety are highly correlated with measures of NA and are often used as measure of NA because of their brevity (Watson & Clark, 1984). To avoid confusion, we will use the term *negative affectivity* instead of trait anxiety. The STAIC-trait is a 20-item questionnaire designed to measure the anxious disposition in children to interpret situations in a threatening way. Participants are asked to use a 3-point scale to indicate how often each statement is true of them ('hardly ever', 'sometimes' or 'often'). Total scores can range from 0 to 40. The STAIC has been shown to be a reliable and valid instrument in previous research (see Bakker et al., 1989; Spielberger et al., 1973).

Procedure

All children, adolescents, and their parents were informed about the research purpose of the study. Informed consent was obtained from all 43 children and their parents. All questionnaires were administered by clinical child psychology trainees.

RESULTS

Descriptive statistics

As expected, the participants in this clinical sample reported high levels of somatic complaints (M = 26.35, SD = 16.73), comparable with findings of Walker and Greene in a sample of children with recurrent abdominal pain (1989). The five most frequently reported severe somatic complaints (i.e. items endorsed 'a lot' or 'a whole lot') were stomach pain (48.8 %), headaches (39.6 %), low energy (32.6 %), nausea/upset stomach (27.9 %), and dizziness (25.6%). At least one severe physical symptom was reported by 90.7% of the sample. Participants reported high levels of pain on the VAS. The mean ratings were 82.98 (SD = 20.53) for the highest pain level, and 47.88 (SD = 30.58) for the average pain level. There were high levels of disability (M = 21.21, SD = 11.30), comparable with previous findings in clinical pediatric pain patients (Kashikar-Zuck et al., 2001). The mean level of pain catastrophizing (M = 21.88, SD = 11.44) was higher than the mean score reported in a sample of non-clinical pediatric pain patients (Crombez et al., 2003).

Correlations

Mean scores, standard deviations, Cronbach α, and Pearson intercorrelations for pain catastrophizing, mean pain severity, somatic complaints, functional disability, and NA are presented in Table 1. There was a significant correlation between pain catastrophizing and NA. Furthermore, pain catastrophizing correlated significantly with somatic complaints, pain severity, and disability. NA was significantly correlated with somatic complaints, but not with pain severity and disability

Additional analyses were conducted to examine whether NA correlated significantly with both the number and mean severity ratings of the somatic complaints reported (see Study 1). Correlation analysis revealed that NA was significantly correlated with the number of somatic symptoms reported (r = .36, $p < .05$), but not with the mean severity ratings of somatic symptoms (r = .14, ns). The correlation of NA with both number and severity of disability was not examined as NA did not correlate significantly with disability.

The predictive value of negative affectivity and pain catastrophizing

Similar regression analyses were performed as in Study 1. The results of these analyses are reported in Table 2. The regression analysis with *somatic complaints* as the dependent variable revealed that both pain catastrophizing ($F_{Change}(1,35) = 9.68$, $p < .01$, $\Delta R^2 = .19$) and NA ($F_{Change}(1,36) = 4.97$, $p < .05$ $\Delta R^2 = .12$) were significant predictors. The analysis with *pain severity* as the dependent variable revealed that only pain catastrophizing was a significant predictor ($F_{Change}(1,35) = 16.84$, $p < .0001$, $\Delta R^2 = .30$). NA was not a significant predictor of pain severity ($F_{Change}(1,36) = .11$, $\Delta R^2 < .01$, ns). Finally, the regression analysis with *functional*

disability as the dependent variable was performed. Again, pain catastrophizing contributed uniquely to the prediction of disability ($F_{Change}(1,34) = 6.38$, $p<.05$, $\Delta R^2 = .11$). NA was not a significant predictor ($F_{Change}(1,35) = 2.85$, $\Delta R^2 = .06$, ns).

The variance-inflation factors of all regression analyses were acceptable (range 1.00 – 1.57), indicating that there was no problem of multicollinearity. As in Study 1, the contribution of the three subscales of the PCS-C could not be examined, as variance-inflation factors (VIF > 2) presented problems for the regression analysis. Because of the small sample size, post hoc power analysis for multiple regression was calculated using G*Power version 2.0 (Faul & Erdfelder, 1992). Results revealed adequate power for all regression analysis (.89, .98 and .95, respectively, for the regression analyses with functional disability somatic complaints, and pain intensity as dependent variable).

Mediation analyses

Conditions to test for mediation were met for the outcome measure of somatic complaints, but not for the measures of functional disability and pain severity. We investigated whether pain catastrophizing mediated the relationship between NA and somatic complaints. The tested model is illustrated in Figure 1. Mediation analyses revealed a Sobel *z*-score = 1.94, p = .05, indicating significant mediation. Pain catastrophizing accounted for 85.06 % of the relationship between NA and somatic complaints.

DISCUSSION

In comparison with Study 1, the experience of somatic complaints is more severe and aversive in our sample of pediatric patients. The children reported a wide diversity of somatic complaints, including a high frequency of non-painful sensations such as nausea, upset stomach, low energy and dizziness. Furthermore, the children reported severe pain and a strong interference with daily functioning.

Despite these differences, the pattern of results was very similar to that of Study 1. Pain catastrophizing was positively related to somatic complaints, pain severity and disability. In contrast, NA was only related to pain catastrophizing and somatic complaints. As in Study 1, children scoring high on NA tend to report a greater diversity of somatic complaints, but not a greater severity. Furthermore, pain catastrophizing, but not the stable disposition to experience negative affect, proved to have an important and unique role in predicting somatic complaints, pain severity and disability. Moreover, pain catastrophizing significantly mediated the relationship between NA and somatic complaints. It is clear that in our clinical sample of children, the effect of pain catastrophizing can also not be accounted for in terms of its overlap with the effect of NA.

GENERAL DISCUSSION

Two studies, one in a more general sample of school children (Study 1) and the second in a clinical sample of children with recurrent or chronic pain (Study 2), were conducted to examine the role of pain catastrophizing and NA in explaining somatic complaints, pain severity, and disability. The results may be readily summarized. First, the unique value of NA in explaining somatic complaints, pain severity and disability was small or non-existent in both studies. Second, the role of pain catastrophizing in explaining somatic complaints, pain severity, and disability was substantial in both studies, even when controlling for the effects of NA. Third, pain catastrophizing mediated the relationship between NA and somatic complaints in studies 1 and 2, and between NA and disability in Study 1. Fourth, in studies 1 and 2 NA had a pronounced effect upon the number of somatic complaints, but not upon their severity. In Study 1 NA had a similar effect upon disability.

The results of both studies clearly add to the small but growing literature on the central role of pain relevant thinking in both normal and chronic childhood pain (e.g.,, Crombez et al., 2003; Piira et al., 2002). The variability in disability and pain complaint cannot be explained by any underlying stable personality variables such as NA, but it *is* a function of more specific cognitive-emotional factors such as pain catastrophizing. Our findings further suggest that children with high levels of NA, are inclined to report a wide diversity of somatic complaints, and functional limitations, but this does not imply that these complaints and limitations are severe.

These findings are in line with adult research showing that NA is related to subjective health measures, but only weakly or inconsistently when disability or severity are taken into account (Ondersma et al., 1997; Watson & Pennebaker, 1989). There are at least two explanations for these findings. First, high NA individuals may be more likely to notice and attend to normal body sensations and minor discomforts than low NA individuals (Watson & Pennebaker, 1989). However, these effects of NA may only be present when somatic complaints are not salient and less intense. Second, high NA individuals may have a general bias to report and to complain about negative events, including minor ones.

Recent progress has been made in extending theories of catastrophizing about pain to a communal context (Sullivan et al., 2001b). Sullivan, Adams, and Sullivan (2004) have argued that catastrophic thinking about pain could usefully be considered, not simply as a private intrapsychic event, but as a social communication of distress. From this point of view, what is important about catastrophizing is the proximity of helpful others and the likelihood that they will react empathically (Crombez & Eccleston, 2002).

The development of a communal model of pain catastrophizing fits very neatly into a systemic understanding of child development and childhood coping with adversity (Compas, Connor-Smith, Saltzman, Thomsen, & Wadsworth, 2001). But if this communal model is to be useful with children, a developmental perspective will be needed (Walco, 2004). For some children, and for most children at some developmental periods, ‘excessive’ fear is normal, and

usually diminishes with age (Gullone, King, & Ollendick, 2001). When a child catastrophizes about pain, the immediate responses of those proximal to the child in providing succour, and the pain behaviours other people model, are likely to be formative of the child's future responses to pain. At present, there is no theory of threat-related thinking in childhood chronic pain that is formed from a developmental perspective. Such theory is needed to account for how the processes of anticipating and avoiding pain segue into the processes that impair coping, worsen suffering and potentially retard social development.

A number of methodological issues in these studies that should be noted. First, although we have shown associations between key variables in two samples, the studies are cross-sectional. We are not able to infer any causal relationships. Second, although we used a reliable and valid measure of somatic complaints, 23% of the items on this measure refer to pain. It is possible that the pain-related item content inflated the effects of pain catastrophizing on somatic complaints. Third, children in the clinical sample of Study 2 presented with various chronic pain problems. Although our results suggest that catastrophic thinking about pain is a key variable in explaining pain, disability, and somatic complaints for a range of chronic pain problems, studies investigating catastrophic thinking about pain in more homogeneous groups is warranted. Fourth, some of the differences between Study 1 and Study 2 may be due to the use of two measures of NA. However, the results of both studies were largely consistent, attesting to the robustness of our findings. Fifth and finally, it should be remembered that there are very few empirical studies of threat-related processes in childhood chronic pain. Replication of these findings with larger samples and from other settings is necessary.

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CHAPTER 2

CHILDREN'S CATASTROPHIC THINKING ABOUT THEIR PAIN PREDICTS PAIN AND DISABILITY SIX MONTHS LATER[1]

ABSTRACT

The present study investigated the prospective roles of catastrophic thinking about pain, pain intensity, and negative affectivity and their putative relationship with pain and disability tested six months later. Participants were 323 schoolchildren. Analyses revealed that the child's pain catastrophizing at baseline had a small but unique contribution to the prediction of pain and disability 6 months later, even when controlling for the initial pain and disability levels. However, moderation analyses revealed that the effects of catastrophizing upon pain and disability at follow-up were only true for those children reporting low levels intensity of pain at baseline. The variability in disability and pain complaint could not be explained by negative affectivity. Instead negative affectivity might be best conceived of as a precursor of catastrophizing in children; i.e. children with higher levels of negative affectivity at baseline were more inclined to report higher levels of catastrophizing at follow-up. The findings are discussed in terms of potential mechanisms through which catastrophizing might exert its negative impact upon pain and disability outcomes in children.

[1] Vervoort, T., Eccleston, C., Goubert, L, Buysse, A., & Crombez, G. (submitted). Children's catastrophic thinking about their pain predicts pain and disability six months later.

INTRODUCTION

Children frequently experience pain (Perquin et al., 2000; Petersen, Brulin, & Bergström, 2006). Most of these experiences are not disabling and go unreported or unnoticed. For a minority of children, however, the repeated experience of pain substantially impairs physical, social and psychological functioning (Kashikar-Zuck, Goldschneider, Powers, Vaught, & Hershey, 2001; Konijnenberg et al., 2005). Although pain intensity has been shown to be important in understanding disability in children (Claar & Walker, 2006; Hunfeld et al., 2001), other factors, above and beyond pain intensity, may constitute a risk factor for the maintenance of pain and disability. In particular, catastrophizing about pain, defined as an exaggerated negative orientation toward actual and anticipated painful stimuli (Sullivan, Bishop, & Pivik, 1995; Sullivan et al., 2001), has emerged as one of the most salient determinants of adjustment to pain in both adults (Sullivan et al., 2001) and children (Crombez et al., 2003; Vervoort, Goubert, Eccleston, Bijttebier, & Crombez, 2006). Additionally, it has also been recognized as an important factor in explaining the transition from acute to chronic pain (Buer & Linton, 2002; Cook, Brawer, & Vowles, 2006; Vlaeyen & Linton, 2000), and as a candidate variable for explaining the extensive disability developed by the minority of children experiencing pain (Crombez et al., 2003; Lynch, Kashikar-Zuck, Goldschneider, & Jones, 2006).

Despite research reporting an increased association between pain catastrophizing and poor health outcomes such as increased pain and disability (Sullivan et al., 2001), several issues remain unaddressed. First, the majority of studies investigating the role of catastrophizing are cross-sectional in design (see e.g. Keefe et al., 2000; Lynch et al., 2006; Sullivan, Stanish, Waite, Sullivan, & Tripp, 1998), and often do not address the extent of pain and disability. Second, although it is known that the tendency to catastrophically appraise threat emerges early in life (Brown, O'Keeffe, Sanders, & Baker, 1986), no study has investigated the role of catastrophizing in children, and its potential risks of fuelling or maintaining later pain and disability. In addition, it is known that the specific effects of pain catastrophizing have a general relationship with the more global effects of negative affectivity (NA), defined as a stable pattern of automatic negative emotional appraisal (Costa & McCrae, 1992). It has been suggested that NA has no direct effect upon pain and disability, but might best be conceived of as a potential precursor of catastrophizing (Goubert, Crombez, & Van Damme, 2004; Vervoort et al., 2006). However, prospective data on the relative importance of NA versus catastrophizing are also lacking.

There were three objectives of this study. First, we investigated whether, in a sample of school children, catastrophizing measured at a baseline (time 1) positively contributes to the prediction of pain and disability measured six months later (time 2). Second, given the significant role of pain intensity for pain and disability outcomes (Claar & Walker, 2006), we investigated whether the relationship between catastrophizing (time 1) and pain and disability (time 2) holds for different levels of pain (time 1). Given that high-intensity pain is less likely to go unnoticed (Crombez, Van Damme, & Eccleston, 2002; Eccleston & Crombez, 1999), the

effects of catastrophizing may be more pronounced at lower pain intensities. As such, we hypothesized that catastrophizing at time 1 might be a vulnerability factor for (1) the increase of pain and (2) pain-related disability at time 2, in particular when pain at time 1 is low. Third, in order to explore the conceptual utility and distinctiveness of catastrophizing, we hypothesized that negative affectivity (NA) will not statistically account for the effects of pain catastrophizing. Instead, we expect that NA might best be conceived of as a precursor of pain catastrophizing (Goubert et al., 2004).

METHOD

Participants

For the assessment at Time 1, twenty-three high schools (grades 4 through 9) were contacted. Eleven schools agreed to participate, yielding a potential sample of 2016 children. Parental informed consent and child assent were obtained for 1376 children, and 1373 children returning completed questionnaires (response rate = 68.11%; 673 boys, 700 girls). Of the 1373, 492 consented to be re-contacted and were approached six months later for the Time 2 assessment. Three hundred and sixty eight children (n = 368; 171 boys, 197 girls), 74.80% of the sample re-contacted, returned completed questionnaires. Drop-out analyses showed that there were no significant differences on socio-demographic and other variables as rated in the baseline study between children entering the study and those who did not consent to participate or did not later respond.

The final sample for which complete data were available consisted of 323 children: invalid composite scores (more than 25% of the items of a given questionnaire not answered) were coded as missing values. The mean age of the sample of children was 12.40 years (SD = 1.46 years, range 9.58 years to 16 years). In terms of school grades, 14.7 percent of the children (n = 54) were recruited from the fourth grade, 19.3% (n = 71) from the fifth grade, 14.7% (n = 54) from the sixth grade, 34% (n = 125) from the seventh grade, and 12% (n = 44) from the eight grade, and 5.4% (n = 20) from the ninth grade.

Instruments

Participants completed a battery of questionnaires assessing pain catastrophizing, pain intensity, functional disability and negative affectivity. Negative affectivity was assessed only at time 1. Pain intensity, functional disability and pain catastrophizing were assessed both at time 1 and time 2 (6-months later).

Catastrophic thinking about pain was assessed with the Dutch version of the *Pain Catastrophizing Scale for Children* (PCS-C; Crombez et al., 2003). This instrument is an adaptation of the adult Pain Catastrophizing Scale (Sullivan et al., 1995). The PCS-C consists of 13 items describing different thoughts and feelings that children may experience when they were in pain. Children rate how frequently they experience each of the thoughts and feelings

when they are in pain using a 5-point scale (0 =‘not at all’, 4 =‘extremely’). The PCS-C yields a total score that can range from 0 to 52, and three subscale scores for rumination, magnification and helplessness. The PCS-C has been shown to be both reliable and valid with children aged from 9 to 15 years (Crombez et al., 2003).

Pain intensity was assessed on a 0- to 10 cm Visual Analogue Scale (VAS; 0 = ‘no pain’, 10 = ‘a lot of pain’. The participants were asked to rate their ‘present’ and ‘highest’ pain intensity in the past two weeks. The mean score of ‘present pain intensity’ and ‘highest pain intensity’ was calculated as an index of pain severity.

Negative affectivity was assessed by the Trait version of the Dutch version *State-Trait Anxiety Inventory for Children* (STAIC-trait; Bakker, Van Wieringen, Van der Ploeg, & Spielberger, 1989; Spielberger, Edwards, Lushene, Montuori, & Platzek, 1973). The STAIC-trait is a 20-item questionnaire designed to measure the disposition in children to interpret situations in a threatening way. Participants are asked to use a 3-point scale to indicate how often each statement is true of them (‘hardly ever’, ‘sometimes’ or ‘often’). Total scores can range from 0 to 40. The STAIC has been shown to be a reliable and valid instrument in previous research (Bakker et al., 1989; Spielberger et al., 1973).

Functional disability was assessed with the Dutch version of the *Functional Disability Inventory* (FDI; Crombez et al., 2003; Walker & Greene, 1991). The FDI is a self-report inventory for children that measures perceived difficulty, due to somatic symptoms, in performing a number of activities in the domains of school, home, recreation, and social interactions. It consists of 15 items to be rated on a 5-point scale (0 to 4), and yields total scores that can range from 0 to 60. The reliability and validity of the FDI has been demonstrated in previous research (Claar & Walker, 2006; Walker & Greene, 1991).

Procedure

Schools were contacted first by letter, then by phone or a visit. After consent was obtained from the school director for this study to take place, teachers and parents were sent a letter explaining the purpose of the study. Written informed parental consent, and child assent, was obtained. Questionnaires for the assessment at baseline (time 1) were administered to the children during regular school hours. Parent questionnaires and parent consent form giving permission for further contact at the 6 month follow-up period (time 2) were sent home with the child. Parents completing the time 1 assessments returned the questionnaires and consent form by mail. Three weeks after time 1 assessment a letter was sent home with all children to remind the parents to fill out the questionnaires and consent form, if not already done, and to return them by mail. For the assessment at time 2 (6 months later), parent and child questionnaires were sent home and returned by mail. A reminder letter to participate was sent home to those parents and children who did not reply within 3 weeks.

RESULTS

Statistiscal analyses

Correlational and regression analyses (using SPSS 15.0) were performed to examine the expected prospective associations between pain catastrophizing, NA, pain, and functional disability. Given we had a priori hypotheses about the direction of effects, one-tailed tests of significance ($p < .05$) were used.

Descriptive statistics

Mean scores, standard deviations, and Cronbach's α coefficients for all measures at Time 1 and at Time 2 (6 month follow up) are presented in Table 1. The mean levels of catastrophic thinking about pain at Time 1 (M = 12.65, SD = 8.10) and Time 2 (M = 11.48, SD = 7.11) were comparable with the mean levels reported in another sample of school children (Vervoort et al., 2006). The Time 1 measure of catastrophizing was significantly higher than the level of catastrophizing at Time 2 ($t(362) = 2.73$, $p<.01$). Children reported similar levels of pain severity on the VAS, compared with other samples of school children (Vervoort et al., 2008). The mean ratings were 16.17 (SD = 22.75) for the present pain level at Time 1, and 12.14 (SD = 19.04) at Time 2, and 42.85 (SD = 30.26) for the highest pain level in the past two weeks at Time 1, and 35.78 (SD = 30.79) at Time 2. The mean pain intensity at Time 1 (M = 29.51, SD = 23.32) was significantly higher than the mean pain intensity at Time 2 (M = 23.96, SD = 22.40; $t(367) = 3.69$, $p<.0001$). The majority of the school children (78.5% at Time 1 and 65.8 % at Time 2) reported at least one pain experience in the past two weeks. Of these children, 23.1% at Time 1 and 20.1 % at Time 2 reported having experienced pain 'only once', 42.7% at Time 1 and 35.9% at Time 2 reported experiencing pain 'sometimes', 10.1% at Time 1 and 9% at Time 2 reported having experienced pain 'often' and 2.2% at Time 1 and 0.8% at Time 2 reported experiencing 'constant' pain. Mean functional disability at Time 1 (M = 6.62, SD = 6.53) and Time 2 (M = 5.27, SD = 6.57) was lower than the mean level reported in a sample of children with chronic pain (Claar & Walker, 2006; Crombez et al., 2003). Time 1 level of functional disability was significantly lower than the mean level of functional disability at Time 2 ($t(333) = 3.51$, $p <.005$). The level of negative affectivity (M = 13.22, SD = 7.36) at Time 1 was lower than the mean level reported in a sample of children with chronic pain (Vervoort et al., 2006).

Correlations

All correlations between variables were significantly positive, varying between .11 and .48 (see also Table 1). Correlation coefficients were higher between constructs measured at the same time, as compared to correlation coefficients between Time 1 and Time 2 measures. Of particular interest for this study were the correlations between pain catastrophizing at Time 1 and the measurements six months later. As expected, analyses revealed significant correlations

between pain catastrophizing at Time 1 and pain intensity and functional disability at Time 2. Of further interest, the test-retest correlation coefficient of catastrophizing measured at Time 1 and Time 2 was significantly positive, but low compared to findings in adult clinical populations in which test-retest correlation coefficients about .80 have been reported over a six month period (see e.g. Keefe, Brown, Wallston, & Caldwell, 1989).

Table 1

Means (M), Standard Deviations (SD), Cronbach's alpha (α) and Pearson intercorrelations of all measures.

	M (SD)	*α*	2	3	4	5	6	7
1. Pain Catastrophizing_t1	12.65 (8.10)	.88	.35***	.44***	.48***	.42***	.13**	.23***
2. Pain Intensity_t1	26.51 (23.32)	---	---	.37***	.28***	.16**	.20***	.22***
3. Functional Disability_t1	6.62 (6.53)	.84		---	.34***	.16**	.17**	.32***
4. Negative Affectivity_t1	13.22 (7.36)	.88			---	.37***	.11*	.19***
5. Pain Catastrophizing_t2	11.48 (7.11)	.86				---	.13*	.39***
6. Pain Intensity_t2	23.96 (22.40)	---					---	.35***
7. Functional Disability_t2	5.27 (6.57)	.88						---

* $p < .05$; ** $p < .01$; *** $p < .0001$; one-tailed significance test

t1 = baseline measure; t2 = follow-up measure (6 months later)

Value of catastrophizing in predicting pain intensity at six months and the moderating role of pain intensity

A hierarchical regression analysis was performed to investigate the contribution of the child's catastrophizing (Time 1) in predicting pain intensity at six months (Time 2) (see Table 2). In addition, we investigated to what extent baseline pain intensity (Time 1) moderates this relationship. To test for pain intensity (Time 1) as a moderator, it is necessary to enter the cross-product terms of pain intensity (Time 1) and pain catastrophizing (Time 1) in a separate block in the hierarchical regression analysis, following the entry of pain intensity (Time 1) and pain catastrophizing (Time 1) as first-order terms (Baron & Kenny, 1986). To reduce the effects of multicollinearity, continues variables were centered (Aiken & West, 1991). In the first step, the child's sex (boys coded as 0, girls coded as 1) and age were entered to control for possible effects of sociodemographic variables. In the second step, negative affectivity (Time 1) was entered. In the third step, the child's pain intensity (Time 1) and pain catastrophizing (Time 1) were entered. In the final step, the interaction term between pain intensity (Time 1) and pain catastrophizing (Time 1) was entered. Variance-inflation factors were acceptable (range 1.04-1.56), suggesting that there was no problem of multicollinearity. Statistically significant interactions were interpreted by plotting regression lines for high and low values of the moderator variable (Aiken & West, 1991; Holmbeck, 2002).

Analyses revealed a significant main effect for age (β = .11, p < .05), indicating that reports of pain intensity increase with increasing age of the child. Sex also had a significant contribution (β = .14, p < .05), with girls reporting higher levels of pain compared to boys. There was no significant contribution of negative affectivity (β = -.01, ns)[2]. Pain intensity at Time 1 significantly predicted pain intensity six months later at Time 2 (β = .19, p < .0001), with higher levels of pain at Time 1 being associated with higher levels of pain intensity at Time 2. After controlling for the child's pain intensity, the contribution of the child's pain catastrophizing (Time 1) was also significant (β = .11, p < .05), with higher levels of catastrophizing being associated with higher levels of pain at six months. The interaction between pain intensity and catastrophizing (Time 1) also had a small, but significant contribution (β = -.11, p < .05). To illustrate the pattern reflected in this statistically significant interaction term, we plotted regression lines for high (+1 *SD* above the mean) and low (-1 *SD* below the mean) values of the moderator variable (Holmbeck, 2002) (see Figure 1). Significance tests for both slopes showed that the slope for the Low Pain intensity regression line was significant (β = .20, p < .05), indicating higher levels of catastrophizing (Time 1) are associated with higher levels of pain intensity at follow-up (Time 2), but only for children who reported low levels of pain intensity (Time 1). The slope for the High Pain intensity regression line did not reach significance (β = .02, ns), indicating that higher levels of pain catastrophizing are not associated with higher levels of pain intensity at Time 2 when the Time 1 level of pain was high.

Table 2

Results of regression analyses predicting pain intensity_t2. Standardized regression coefficients (β) from the last step in the analyses are shown.

Step	Predictor	β	ΔR^2	Adjusted R^2
1	Age	.11*	.03**	.03
	Sex	.14*		
2	Negative affectivity_t1	-.01	.006	.03
3	Pain intensity_t1	.19**	.04***	.06
	Pain catastrophizing_t1	.11*		
4	Pain intensity_t1 × Pain catastrophizing_t1	-.11*	.01*	.07

*p < .05; ** p < .01 *** p < .001; one-tailed significance test.

[2] Exploration whether the effect of negative affectivity upon pain intensity at follow-up is dependent upon level of catastrophizing (Time 1) revealed no significant interaction effect.

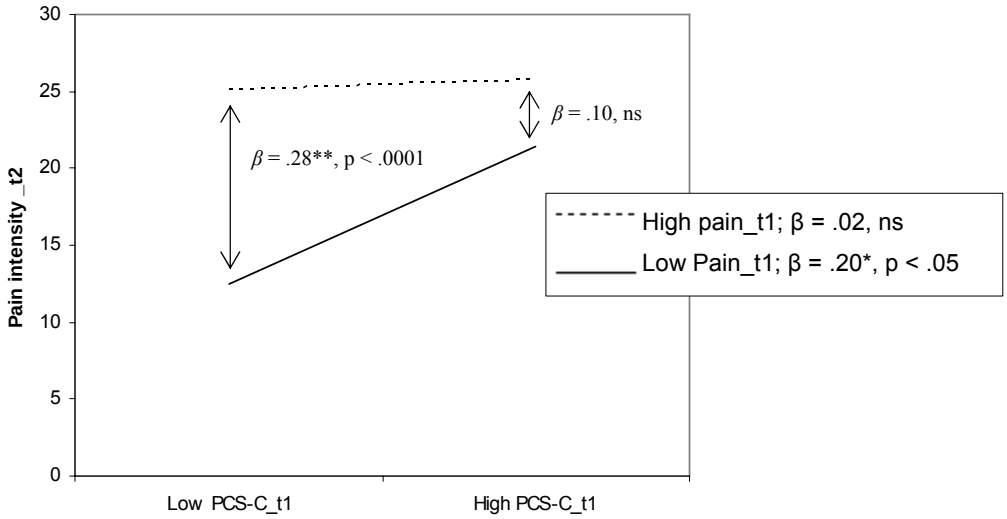

Figure 1*: Regression lines for the relationship between the child's pain catastrophizing at baseline (time 1) and pain intensity at follow-up (time 2) as moderated by baseline pain intensity level of the child (time 1). Standardized Beta's (β) are shown (PCS-C = Pain Catastrophizing Scale for Children).*

* p < .05, ** p < .0001

Value of catastrophizing in predicting functional disability at six months and the moderating role of pain intensity

A hierarchical regression analysis was performed to investigate the contribution of the child's catastrophizing (Time 1) in predicting functional disability at six months (see Table 3) and the moderating role of pain intensity (Time 1). The regression analyses with functional disability (Time 2) as dependent variable was similar to the regression analysis with pain intensity (Time 2) as dependent variable, except that we now also controlled for the level of functional disability at Time 1 in the third step of the analysis. Again, variance-inflation factors were acceptable (range 1.06- 1.60), suggesting that there was no problem of multicollinearity.

Analyses revealed a significant effect for age (β = .10, p < .05), indicating that reports of functional disability increase with increasing age of the child. There were no significant effects for sex (β = .07, ns) and negative affectivity (β = .01, ns)[3]. Baseline level of functional disability (Time 1) had a significant contribution (β = .26, p < .0001), indicating that higher levels of disability (Time 1) are associated with higher levels of disability later (Time 2). Pain intensity at Time 1 had also a significant contribution (β = .12, p <.05), indicating that higher levels of baseline pain are associated with higher levels of functional disability 6 months later. After controlling for the child's initial level of functional disability (Time 1) and pain intensity (Time 1), the contribution of the child's pain catastrophizing (Time 1) was significant (β = .11, p <

[3] Exploration whether the effect of negative affectivity upon pain intensity at follow-up is dependent upon level of catastrophizing (Time 1) revealed no significant interaction effect.

.05), with higher levels of baseline catastrophizing being associated with higher levels of functional disability at six months. The interaction between pain catastrophizing (Time 1) and pain intensity (Time 1) was also significant (β = -.10, p < .05) indicating that the relationship between catastrophizing (Time 1) and functional disability (Time 2) is conditional on initial levels of pain intensity (Time 1). Significance tests for the Low (- 1*SD* below the mean) and High (+ 1*SD* above the mean) pain intensity regression line indicated that the slope for the Low Pain intensity regression line was significant (β = .19, p < .05), indicating higher levels of catastrophizing at Time 1 are associated with higher levels of functional disability at six months later, but only for children who reported low levels of pain intensity at Time 1. The slope for the High Pain intensity regression line did not reach significance (β = .03, ns), indicating that higher levels of pain catastrophizing are not associated with higher levels of functional disability at follow-up when the baseline level of pain (Time 1) was high.

Table 3

Results of regression analyses predicting functional disability_t2. Standardized regression coefficients (β) from the last step in the analyses are shown.

Step	Predictor	*β*	*ΔR²*	*Adjusted R²*
1	Age	.10*	.02*	.01
	Gender	.07		
2	Negative affectivity_t1	.01	.03*	.04
	Functional disability_t1	.26***	.08***	
3	Pain intensity_t1	.12*	.02*	.21
	Pain catastrophizing_t1	.11*		
5	Pain intensity_t1 × Pain catastrophizing_t1	-.10*	.01*	.22

*p < .05; ** p < .001; *** p < .0001; one-tailed significance test.

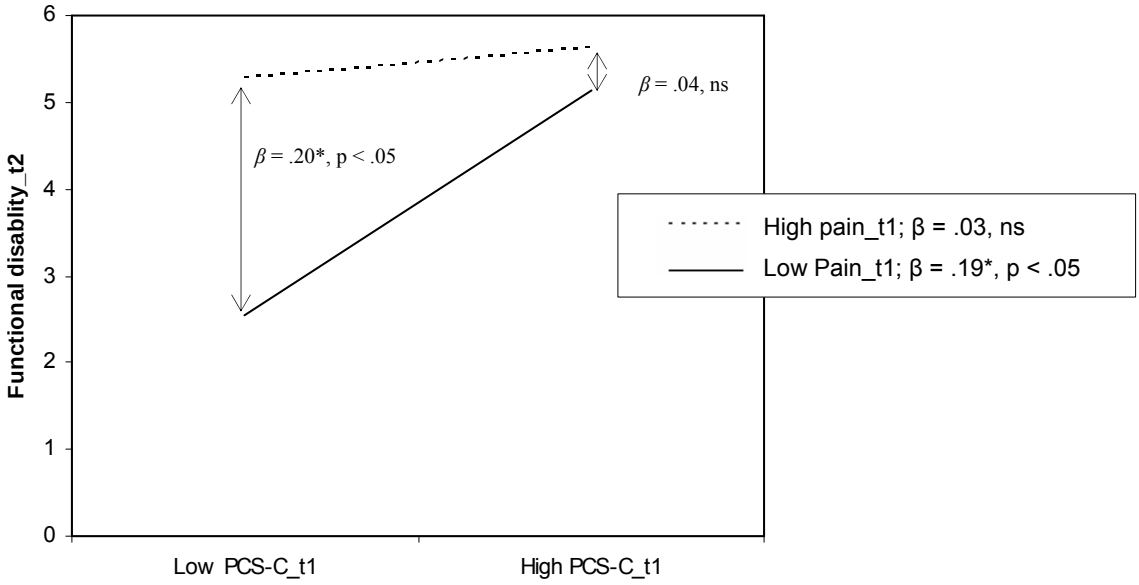

Figure 2: *Regression lines for the relationship between the child's pain catastrophizing at baseline (time 1) and functional disability at follow-up (time 2) as moderated by baseline pain intensity level of the child (time 1). Standardized Beta's (β) are shown (PCS-C = Pain Catastrophizing Scale for Children).*

* p < .05

The relationship between negative affectivity (NA) and pain catastrophizing

Following first, the results of the present study indicating that the effects of pain catastrophizing upon pain and disability at follow-up cannot be accounted for by negative affectivity, and second, the results of previous studies suggesting that NA might be conceived of as a precursor to catastrophizing (see e.g. Goubert et al., 2004), a hierarchical regression analysis was performed to investigate the contribution of negative affectivity at Time 1 in predicting pain catastrophizing six months later (Time 2) (see Table 4). Similar to previous regression analyses, we also controlled for the child's sex and age in the first step of the analysis. To examine the antecedent status of pain and disability for catastrophizing, pain intensity (Time 1) and functional disability (Time 1) were entered in the second step. In the third step, the child's pain catastrophizing (Time 1) was entered. In the fourth step, the child's level of negative affectivity (Time 1) was entered. Again, variance-inflation factors were acceptable (range 1.05 – 1.56), suggesting that there was no problem of multicollinearity.

Analyses revealed no significant effects for age (β = .06, ns), sex (β = -.01, ns), baseline pain intensity (β = -.01, ns) and functional disability_t0 (β = -.05, ns). As expected, baseline level of catastrophizing (Time 1) had a significant contribution (β =.34, p < .0001), indicating that higher levels of catastrophizing at Time 1 are associated with higher levels of catastrophizing at Time 2. After partialling out the influence of age, sex, pain intensity, functional disability and baseline catastrophizing, negative affectivity, uniquely contributed to the prediction of

catastrophizing_t2 (β =.24, p < .0001); higher levels of NA are independently associated with higher levels of catastrophizing 6 months later[4].

Table 4

Results of regression analyses predicting Pain catastrophizing_t2. Standardized regression coefficients (β) from the last step in the analyses are shown.

Step	Predictor	β	ΔR^2	Adjusted R^2
1	Age	.06	.01	.01
	Gender	-.01		
2	Pain intensity_t1	-.01	.04**	.04
	Functional disability_t1	-.05		
3	Pain catastrophizing_t1	.34***	.13***	.17
4	Negative affectivity_t1	.24***	.04***	.21

** p < .001; *** p < .0001; one-tailed significance test.

DISCUSSION

This study of school attending children was designed to investigate the prospective roles of catastrophic thinking about pain, pain intensity, and negative affectivity and their putative relationship with pain and disability tested six months later. The results were largely as predicted. First, the child's pain catastrophizing at baseline had a unique contribution to the prediction of pain and disability 6 months later, even when controlling for the initial pain and disability levels. Second, moderation analyses revealed that the effects of pain catastrophizing upon pain and disability 6 months later were only true for those children reporting low levels intensity of pain at baseline. In other words, catastrophizing about pain, in particular when pain is mild in intensity, may be a risk factor for later pain and disability. Third, the variability in disability and pain complaint could not be explained by negative affectivity. Instead negative affectivity might be best conceived of as a precursor of catastrophizing in children; i.e. children with higher levels of negative affectivity at baseline were more inclined to report higher levels of catastrophizing at follow-up. These findings do not support the idea that catastrophizing is only an instantiation of negative affectivity (Turner & Aaron, 2001). The effects of both variables are not interchangeable, rather catastrophizing may arise as a function of predispositional factors such as negative affectivity (see also Crombez, Eccleston, Van den Broeck, Van Houdenhove, & Goubert, 2002; Goubert et al., 2004).

[4] Exploration whether the relationship between negative affectivity (Time 1) and pain catastrophizing (Time 2) is moderated by the child's level of pain intensity (Time 1), functional disability_(Time 1) or pain catastrophizing (Time 1) revealed no significant interaction effects.

Our findings are consistent with previous results demonstrated in cross-sectional studies with children and adults (Crombez et al., 2003; Sullivan et al., 1995; Vervoort et al., 2006) and prospective studies with adults (Keefe et al., 1989; Sullivan et al., 1995), and also extend the earlier results in several ways. First, to our knowledge, this is the first study to prospectively investigate the role of pain catastrophizing and negative affectivity in a sample of school children. Second, we focus on the specific conditions under which pain catastrophizing exerts its negative influence. Our results corroborate previous findings from cross-sectional studies that pain catastrophizing is a significant variable in understanding pain and disability outcomes in children (Crombez et al., 2003; Lynch et al., 2006; Vervoort et al., 2006). They extend previous findings by indicating that higher levels of catastrophizing contribute to deleterious pain and disability outcomes only when their initial pain intensity level was low. Children who reported high levels of pain at baseline were inclined to report high levels of pain and disability 6 months later, regardless of their level of catastrophizing.

The present findings indicate that characteristics relating primarily to pain (e.g. pain intensity), and specific motivational and cognitive-affective factors (e.g. pain catastrophizing) intersect in predicting pain and disability outcomes. Our results further indicate that catastrophizing might be important in understanding the onset of higher levels of pain but less so for the maintenance of high levels of pain. There are several possible pathways through which pain catastrophizing might affect pain and disability (Edwards, Bingham, Bathon, & Haythornthwaite, 2006).

First, catastrophizing about pain may affect pain intensity and disability through processes related to *vigilance* to threat. In particular, catastrophic thinking about pain has been found to induce a hypervigilance to pain (Crombez et al., 2005; Van Damme, Crombez, & Lorenz, 2007; Van Slyke & Walker, 2006). High catastrophizers may therefore be attentionally biased towards pain or pain-related information. For high catastrophizing children, the experience of pain *in and of itself* may reflect high threat and hence, may be attentionally demanding (Crombez, Eccleston, Baeyens, & Eelen, 1998; Crombez, Vlaeyen, Heuts, & Lysens, 1999). Previous findings indicating that threat itself, above and beyond the intensity of pain, is sufficient to interrupt attention (Eccleston & Crombez, 1999), to decrease coping efficacy with pain (Heyneman, Fremouw, Gano, Kirkland, & Heiden, 1990; Sullivan et al., 1995) and to interfere with daily functioning by inducing avoidance behaviours (Crombez et al., 1999),suggest that appraisal and attentional processes might be invoked to explain how catastrophizing exerts its negative influence upon pain and disability outcomes (Crombez et al., 1998; Sullivan et al., 2001).

Second, catastrophizing may also enhance pain and disability via its effects on the social environment (Buenaver, Edwards, & Haythorntwaite, 2007). In particular, it has been suggested that high catastrophizers' appraisals of pain as extremely threatening and difficult to cope with may elicit attempts to seek support from others, for instance by the overt display of pain (Sullivan, Martel, Tripp, Savard, & Crombez, 2006; Sullivan et al., 2001). This pathway is not independent from the hypervigilance route expounded above, but perhaps an environmental

extension. Heightened threat may not only be attentionally demanding for the individual in pain, but may, through encoding into expressive behaviours, also draw upon other's attention and responsiveness. In support of this view, studies with adults have indicated that higher levels of pain catastrophizing are associated with higher levels of pain expression (Sullivan, Adams, & Sullivan, 2004; Sullivan et al., 2006), yet may elicit not only solicitous (Giardino, Jensen, Turner, Ehde, & Cardenas, 2003), but also critical or punishing responses (Cano, 2004; Keefe et al., 2003). Both types of responses, however, may be mechanisms by which catastrophizing exerts a detrimental effects upon pain outcomes (Buenaver et al., 2007). Solicitous responses may enhance a persons' tendency to avoid pain (Peterson & Palermo, 2004; Van Slyke & Walker, 2006). Punishing responses may add to the aversiveness of pain experiences in ways that similarly enhance avoidance (Buenaver et al., 2007; McCracken, 2005). Few studies, however, have examined pain catastrophizing in children in the context of seeking or demanding help. Preliminary findings are in line with adult literature; higher levels of catastrophizing in children are associated with a more expressive orientation in dealing with pain (Bédard, Reid, McGrath, & Chambers, 1997; Vervoort et al., 2008). However, its association with others' responses remains to be investigated.

Of further interest, the children of the present sample showed a rather moderate degree of consistency in their level of catastrophizing over a 6 months period. Although comparisons with other studies are difficult given differences in sample characteristics or time periods, our test-retest correlation coefficient is only half from those that have been reported in other studies with adults (Keefe et al., 1989; Sullivan et al., 1995). This might indicate that, especially in children, catastrophizing is not a very stable response to pain but might be better perceived as a modifiable and more situation-specific cognitive style (Ellis & D'Eon, 2002; Turner & Aaron, 2001). Given that catastrophizing is associated with negative pain related outcomes ánd appears to become more stable in adults than in children, it is important to examine the dynamic properties of catastrophizing throughout child development to come to an understanding of variables that are likely to minimize or promote catastrophizing. As suggested by our findings, children reporting high levels of negative affectivity might be particularly vulnerable to catastrophizing.

There are a number of limitations to this study to be considered. First, the study sample consisted of school children. Further research is needed to examine the generalizability of the results to samples of children with chronic or clinical pain. Second, the measure of disability used in the present study does not evaluate impairment exclusively due to pain. Children were asked to rate perceived difficulty of performing each activity due to 'physical health'. Most likely, this has resulted in an underestimation of the associations between disability, pain catastrophizing and pain. Third, explained variance rates were small. Other factors, both child-related factors, such as depression (Gauntlett-Gilbert & Eccleston, 2007; Hoff, Palermo, Schluchter, Zebracki, & Drotar, 2006) and parent-related factors, such as parental attention to their child's pain (Chambers, Craig, & Bennett, 2002) need to be taken into account. Fourth, this study was designed conceptually and specifically to focus on the effects of specific variables.

Extrapolation to the naturalistic case is premature. Finally, although our findings indicate catastrophizing has an antecedent status for pain and disability outcomes, the present study does not provide a test of whether catastrophizing is a direct cause of pain and disability. As suggested above, there might be several possible mechanisms underlying or mediating this relationship.

This prospective study is an advance on cross-sectional analyses that dominate the literature. However, this study is prospective in the most minimal form: with a measurement at only two time points. To truly investigate the relational and developmental context of children's pain and pain related behaviour further research is necessary that extends the methodological canon. Prospective studies assessing variables, at least, at 3 consecutive points in time are necessary to make causal inferences about mediation (Cole & Maxwell, 2003). Daily diary studies are possible that allow the assessment of the variability and sensitivity, both within persons and between persons, of anxious behaviour in response to pain. Missing is any understanding of specific pain-related life events and their effects on learning. And finally, some understanding of the role of protective or pain promoting effects of significant others such as parents or peers will be an invaluable part of the picture (e.g. Eccleston, Wastell, Crombez, & Jordan, (in press).

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PART II

PAIN CATASTROPHIZING AND PAIN EXPRESSION IN CHILDREN AND ADOLESCENTS

CHAPTER 3

EXPRESSIVE DIMENSIONS OF PAIN CATASTROPHIZING: A COMPARATIVE ANALYSIS OF SCHOOL CHILDREN AND CHILDREN WITH CLINICAL PAIN[1]

ABSTRACT

We investigated the role of the child's pain catastrophizing in explaining (1) children's self-reported tendency to verbally share their pain experience with others and (2) different dimensions of pain expression, as described by the mother and the father, including non-verbal and verbal communicative pain behaviour and protective pain behaviour. Participants were school children, children with chronic or recurrent pain, and their parents. The results showed that: (1) Pain catastrophizing was associated with children's greater self-acknowledged tendency to verbally share their pain experience with others. (2) Mothers and fathers perceived highly catastrophizing children to be more communicative about their pain. (3) The role of pain catastrophizing in the child's verbal sharing of pain experiences and in explaining expressive behaviour as rated by parents did not differ between the school children and children with recurrent and chronic pain. (4) Nevertheless, findings indicated marked differences between school children and the clinical sample. Children of the clinical sample experienced more severe pain, more pain catastrophizing, more protective pain behaviour, but less verbal communications about their pain. These results further corroborate the position that catastrophic thoughts about pain have interpersonal consequences. Findings are discussed in terms of the possible functions and effects upon others of pain catastrophizing and associated categories of pain behaviour.

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[1] Vervoort, T., Craig, K.D., Goubert, L., Dehoorne, J., Joos, R., Matthys, D., Buysse, A., & Crombez, G. (2008). Expressive dimensions of pain catastrophizing: A comparative analysis of school children and children with clinical pain. *Pain, 134,* 59-68.

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INTRODUCTION

Pain demands attention and urges actions toward mitigating it (Eccleston & Crombez, 1999). Actions, such as withdrawal, guarding and rubbing, are often viewed as *protective* behaviours, but they might also serve as cues for others to infer pain (Craig, 2004; Williams & Craig, 2006). Some behaviours, such as facial pain expressions and pain verbalizations, do not necessarily serve an immediate or physical protective function, but have a primary communicative intent (Sullivan et al., 2006a). The adaptive value and evolutionary origins of these *communicative* pain behaviours probably arose as a consequence of their powerful capacity to signal pain, and to engage others' help and care (Hadjistavropolous & Craig, 2002; Williams, 2002).

Numerous interpersonal and intrapersonal factors have been identified that are likely to influence how pain becomes manifest socially. The mere presence of others, for example, parents, peers, or health care providers, have an impact on behavioural expression (Langford et al., 2006; Zeman & Garber, 1996). Beyond these audience effects, certain thoughts and feelings about pain also have an impact. Pain catastrophizing, defined as "an exaggerated negative orientation towards actual or anticipated pain experiences" (Sullivan, Bishop, & Pivik 1995), is a major determinant of intrapersonal features of pain, including heightened pain intensity, distress and disability (Sullivan et al., 2001). Because high levels of catastrophizing also have been found to be associated with a wide range of observable pain and illness behaviours (Bédard, Reid, McGrath, & Chambers, 1997; Sullivan, Tripp, & Santor, 2000), Sullivan et al. (2001) suggested that pain catastrophizing also has intrinsic interpersonal features. According to these authors, high catastrophizers seek social support by overt display of pain, because they feel threatened and helpless about their pain. As observers predominantly rely upon communicative pain behaviours to infer pain ratings (Deyo, Prkachin, & Mercer, 2004; Sullivan, Martel, Tripp, Savard, & Crombez, 2006b), catastrophizers' heightened pain expression may therefore function as social communications directed toward obtaining proximity and support.

To date, evidence for the association between pain catastrophizing and pain expression, in particular more *communicative* pain behaviour, stems from studies with adults (Keefe et al., 2003; Sullivan et al. 2006b). However, the role of pain catastrophizing in pain expression might be of particular importance in children. Parents have the primary responsibility to care and socialize their children. They are often present when their child experiences pain, and may thus fundamentally affect how the child experiences pain and how the child copes with the current pain but also future pain (Chambers, 2003; Palermo & Chambers, 2005).

This study was designed to investigate the expressive dimensions of pain catastrophizing in school children and children experiencing clinically significant pain. We hypothesized that in both samples pain catastrophizing would be associated with (1) a higher self-reported tendency of the child to verbally share their pain experience with others and with (2) higher parental perceptions of pain behaviour of their child. In addition, we explored differences in pain

expression between the two samples, and the associations of catastrophizing with protective and communicative pain behaviours.

METHOD

Participants

School sample: Nine schools with grades 4 through 9 were contacted, with seven schools agreeing to participate. Teachers and parents received a letter in which the purpose of the study was explained. Of the 1,486 parents and children approached, parental informed consents and child assents were obtained for 912 children (response rate = 61.3%). For 660 (332 boys, 327 girls) of these 912 children, at least one of the parents (633 mothers and 488 fathers) also agreed to participate in this study (response rate = 72.4 %). No data are available on non-responders. Almost one fifth (18.8%) of the children (n = 124) were recruited from the fourth grade, 23.6% (n = 156) from the fifth grade, 9.2% (n = 61) from the sixth grade, 13.9% (n = 92) from the seventh grade, 15.8% (n=104) from the eight grade, and 18.6% (n = 123) from the ninth grade. The mean age of the sample of children was 12.23 years (SD = 1.85, range 9.08 years to 15.5 years). The mean age of the mothers was 40.43 years (SD = 4.04; range = 27 years to 54 years) and for the fathers 42.32 years (SD = 4.74; range = 32 years to 64 years). The majority (528; 80%) of the parents was married or co-habiting. Approximately 50 % of the parents had a higher education (beyond the age of 18 years). Questionnaires were administered to the children during regular school hours. Questionnaires and informed consents for the parents' participation were sent home with the child. Parents (both mothers and fathers) completed these questionnaires at home and returned them by mail.

Clinical sample: Children with chronic or recurrent pain warranting clinical intervention and their parents were recruited from an outpatient Rheumatology clinic on a consecutive basis. All children and their parents were informed about the purpose of the study by their rheumatologist during a routine consult, and their interest in participating was established. Inclusion criteria included (1) the parents and the children were Dutch-speaking, (2) children were between the age of 8 and 18 years.

A total of 71 pairs of children and their parents were approached and invited to participate in this study. Of these, 6 did not wish to take part, mainly because of lack of time. Of the 65 children for whom informed child assent and parental consent was obtained, 61 children (35 girls, 26 boys), 34 fathers, and 52 mothers returned completed questionnaires. The mean age of the children was 13.33 years (SD = 2.83; range: 8.08 years to 18.42 years). Forty-three (70.5%) of the children were suffering recurrent pain. The remainder was identified as suffering persistent chronic pain. Of the 61 children, 41% had a diagnosis of polyarthritis, 29% had oligoarthritis. The majority of children (83.6%) were taking pain medication. The mean duration of the chronic or persistent pain was 61.77 months (SD= 46.53 months). The mean age of the mothers and the fathers was, respectively, 42.32 years (SD = 4.16; range = 31.75 years to 53.08

years) and 44.63 years (*SD* = 6.85; range = 24.42 years to 60.58 years). The majority (86.9%) of the parents was married or co-habiting. Approximately 45% of the parents had a higher education (beyond the age of 18 years). Questionnaires were administered by clinical psychology trainees. Postal return of questionnaires was allowed, but not encouraged.

Instruments

Child report measures

Catastrophic thinking about pain was assessed with the Dutch version of the Pain Catastrophizing Scale for Children (PCS-C; Crombez et al., 2003). This instrument is an adaptation of the adult Pain Catastrophizing Scale (Sullivan et al., 1995). The PCS-C consists of 13 items describing different thoughts and feelings that children may experience when they were in pain. Instructions of the PCS-C are similar to those of the original PCS (Sullivan et al., 1995). Children rate how frequently they experience each of the thoughts and feelings when they are in pain using a 5-point scale (0 ='not at all', 4 ='extremely'). The PCS-C yields a total score that can range from 0 to 52, and three subscale scores for rumination, magnification and helplessness. The PCS-C has shown to be a reliable and valid instrument in children from 9 to 15 years (Crombez et al., 2003).

Pain severity was assessed by two Visual Analogue Scales (VAS). Children reported on pain experienced during the last two weeks. Children rated their 'most severe pain' in the past two weeks and their 'present pain severity' on a 100 mm VAS with the end points labelled 'no pain' and 'a lot of pain'. The pain severity VAS has good reliability and validity in children 9 to 15 years old (McGrath, 1987). We calculated the mean score of 'present pain intensity' and 'most severe pain' as an index of pain severity. Further, frequency of pain episodes (0 = 'none', 4 = 'constant') during the last two weeks was assessed.

The tendency of the child to verbalize his or her pain experience to others was assessed by means of a slightly adapted version of the 'seeking social support' subscale of the Dutch version of the Pain Coping Questionnaire (PCQ; Bandell-Hoekstra et al., 2002; Reid, Gilbert, & McGrath, 1998). The PCQ consists of 8 subscales (information seeking, problem solving, seeking social support, positive self-statements, behavioural distraction, cognitive distraction, externalizing, internalizing/catastrophizing) and three higher-order scales (approach, problem-focused avoidance, emotion-focused avoidance) and has demonstrated good reliability and validity in both healthy children and children with pain (Bandell-Hoekstra et al., 2002; Reid et al., 1998). For this study, the 'seeking social support' subscale, which consists of 5 items, was adapted. First, the stem 'When I am hurt or in pain for a few hours or days…' was changed to 'When I'm in pain'. Secondly, the item 'When I'm in pain, I talk to someone about how I'm feeling' was omitted because of its strong overlap with the item 'When I'm in pain, I tell someone how I feel''. Consistent with the original scale, children rated how often they used each of the 4 items when they were in pain using a 5-point scale (0 ='never', 1 = 'hardly ever', 2 = 'sometimes', 3 = 'often', 4 ='always'). As all items of this 4-item social support seeking

scale explicitly refer to 'talking about pain with someone else', and to avoid ambiguity in interpretation of findings, the 'seeking social support' scale was renamed into 'Pain Verbalizations Scale'. The 'Pain Verbalizations Scale' yields a total score that can range from 0 to 16.

Parent report measures

Pain expressiveness of the child was assessed by means of a 10-item questionnaire, the Pain Expression Scale, specifically designed for the purpose of this study, and administered to the parents. This questionnaire was developed based upon inspection of several observational pain checklists that allow parents to describe their children's pain (Breau, McGrath, Camfield, Rosmus, & Finley, 2000; Keefe & Block, 1982; Moores & Watson, 2004; Turk, Wack, & Kerns, 1985). An attempt was made to cover all different kinds of pain behaviour (e.g., verbal pain expression, non-verbal pain expression like changes in the domain of eating or sleeping, facial expression, changes in the level of activity/movement of the child and other physical signs like crying). Further, in line with theoretical conceptualisations about the primary functions of pain behaviour (Williams, 2002; Sullivan et al., 2006a), items were a-priori categorized to reflect either non-verbal communicative pain behaviour (3 items; e.g., 'When my child is in pain, he/she will show a painful face), verbal communicative pain behaviour (3 items, e.g., 'When my child is in pain, he/she will talk about it') or protective pain behaviour (4 items; e.g., 'When my child is in pain, he/she will play less then usual). Parents rated how frequently their child displayed each of the pain behaviours when their child was in pain, using a 5-point scale (0 ='not at all', 4 ='always'). The communicative non-verbal and verbal pain behaviour scales each yield a total score that can range from 0 to 12. The protective pain behaviour scale yields a total score that can range from 0 to 16.

As this scale was used for the first time, the three-factor structure of the 'Pain expression scale' was examined by means of confirmatory factor analysis (CFA) using Amos 5.0 (Arbuckle, 2003; Arbuckle & Wothke, 1995, 1999). The standardized factor loadings and correlations between the three factors of the validated and cross-validated model for the school sample are presented in Figure 1. The model fit was assessed using (a) χ^2 divided by the degrees of freedom (CMIN/DF); (b) the Root Mean Square Error of Approximation (RMSEA), (c) the Comparative Fit Index (CFI) and (d) the Goodness of Fit Index (GFI). CMIN/DF ratios as low as 2 or as high as 5 indicate a reasonable fit (Marsh & Hocevar, 1985). A RMSEA value of 0.05 indicates a close fit and values up to 0.08 represent reasonable errors of approximation in the population (Browne & Cudeck, 1993). CFI and GFI values greater than 0.90 indicate an adequate fit (Bentler, 1990; Tanaka & Huba, 1985). The model was validated upon half of the sample of school children and cross-validated upon the remainder 50% of the sample of school children.

Initially, the three-factor model did not achieve acceptable fit for all fit measures (i.e., CMIN/DF > 11; RMSEA > .13; CFI <.88; GFI <.88). Modification indices indicated that the model could be improved with respecification of some parameters. Correlated residuals between

items 1 and 5, and items 8 and 9 were detected. As these items are closely related in content (i.e. with items 1 and 5 referring to 'talking' to others about the pain, and items 8 and 9 referring to reduced activity), a modified three-factor model was refit to the data, freely estimating the error covariance between these items. Fit increased substantially and was adequate (CMIN/DF = 1.95; RMSEA = .04; CFI = .99; GFI = .98). Crossvalidation of this modified three-factor model on the other sample of parents of schoolchildren also revealed an adequate fit (CMIN/DF = 3.17; RMSEA = .06; CFI = .97; GFI = .97). In addition, this modified three-factor model also showed an adequate fit (CMIN/DF = 1.10; RMSEA = .03; CFI = .99; GFI = .93) for the clinical sample.

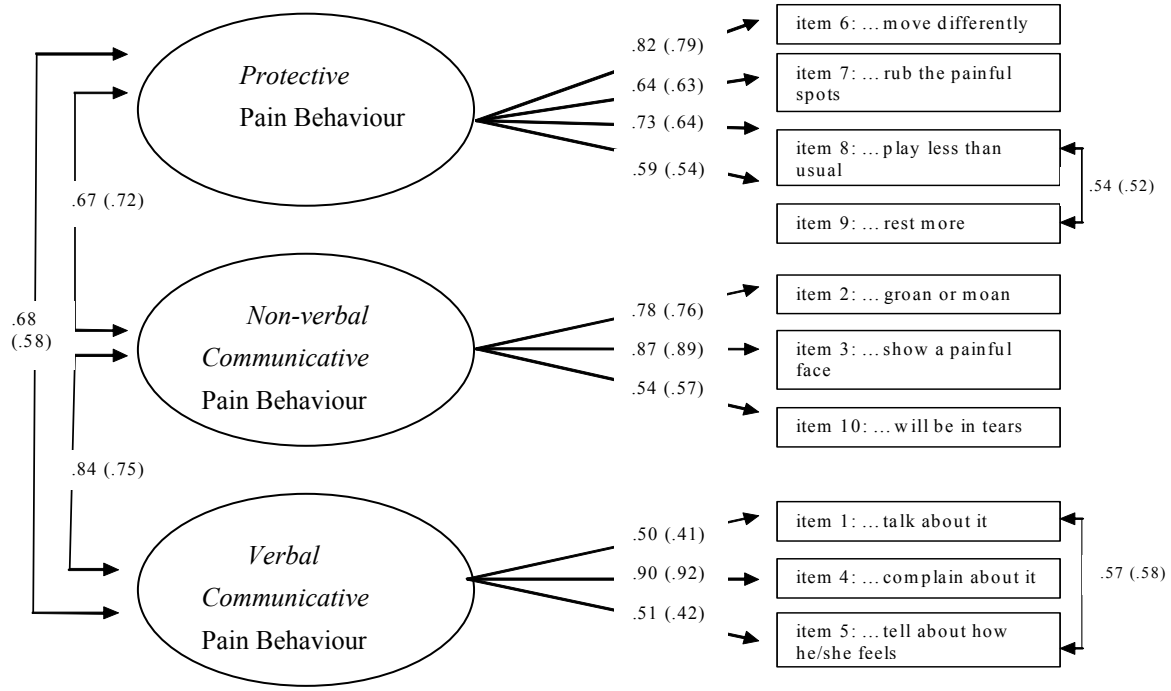

Figure 1: *Standardized factor loadings of the modified three-factor model of parental perception of pain expressiveness of their child as obtained with confirmatory factor analysis are shown for parents of children from the school sample (with standardized factor loadings of the cross-validated model between parentheses).*

RESULTS

Descriptive statistics

The final sample providing complete data consisted of 720 children (61 from the clinical sample), 684 mothers (52 from the clinical sample) and 518 fathers (34 from the clinical sample): invalid composite scores (more than 25% of the items of a given questionnaire not answered) were coded as missing values. Mean scores, standard deviations, and Cronbach's α coefficients for all parent and child measures for both groups (school children and children with chronic or recurrent pain) are presented in Table 1. In the following, several significant differences between the school sample and the clinical sample are reported. According to the criteria of Cohen (1988), the effect sizes of the significant differences between the clinical sample and the school sample were small to medium.

The majority of the school children (84.7 %) reported at least one pain experience in the past two weeks. Of these children, 24.2% reported having experienced pain 'only once', 48.9% 'sometimes', 9.2% 'often' and 2.1% reported experiencing 'constant' pain. More than three quarters (78.69 %) of the children with chronic or recurrent pain reported at least one pain experience in the past two weeks. Of these children, 29.17% reported having experienced pain 'only once', 31.25% 'sometimes', 20.83% 'often' and 18.75% reported experiencing 'constant' pain. The mean *pain intensity* within the clinical sample was higher than the mean score of the sample of school children ($t(719) = -2.15$, $p < .05$; Cohen's $d = .24$). Similarly, the mean level of catastrophic thinking about pain in the clinical sample was higher than in the community sample of school children ($t(719) = -3.92$, $p < .0001$; Cohen's $d = .45$). The mean score on self-reported tendency of the child to '*verbalize pain with others*' within the sample of children with recurrent or chronic pain was lower than the mean score reported by the sample of school children ($t(719)=3.19$, $p < .005$; Cohen's $d = .40$).

Comparison on the Pain Expression Scale of the three pain behaviour scales between groups revealed that, for mothers of schoolchildren, perceptions of *protective* pain behaviour in their child were lower than those of mothers of the children with chronic or recurrent pain ($t(685) = -3.49$, $p < .005$; Cohen's $d = .46$). The mean ratings of mothers for the *non verbal communicative* pain behaviours revealed no differences between groups ($t(682)=.91$; Cohen's $d = .14$). However, mothers of schoolchildren perceived more *verbal communicative* pain behaviour in their child than mothers of the children with chronic or recurrent pain ($t(682) = 4.54$, $p < .0001$; Cohen's $d = .60$). For fathers, comparison of the three pain behaviour scales between groups revealed similar results. Like mothers, fathers of schoolchildren perceived less *protective* pain behaviour in their child than fathers of the children with chronic or recurrent pain ($t(521) = -2.86$, $p < .005$; Cohen's $d = .54$). There were also no differences between groups for paternal perception of *non verbal communicative* pain behaviours ($t(516)= 1.42$, ns; Cohen's $d = .26$). Finally, ratings of the father of *verbal communicative* pain behaviour of the school

children were higher than the mean scores reported by fathers ($t(518) = 2.24$, $p < .05$; Cohen's $d = .38$) of the sample of children with chronic or recurrent pain[2].

Table 1

Means, standard deviations (SD), internal consistency (Cronbach's alpha) for all child and parent measures of the school sample and the clinical sample.

	School Sample				Clinical Sample				
	n	α	*M*	*SD*	*n*	α	*M*	*SD*	*t*
Pain Catastrophizing	660	.86	12.24	7.55	61	.91	16.34	10.31	***
Child's Pain Verbalizations	660	.66	7.87	3.18	61	.82	6.49	3.81	**
Pain intensity	660	---	27.22	20.9	61	---	33.56	31.50	*
Protective Pain Behaviour – M	635	.79	6.85	3.03	52	.81	8.40	3.68	**
Non-verbal Communicative Pain Behaviour – M	632	.76	4.22	2.28	52	.70	3.92	2.14	Ns
Verbal Communicative Pain Behaviour - M	632	.74	7.76	2.62	52	.80	6.02	3.11	***
Protective Pain Behaviour – F	489	.82	7.03	3.05	34	.55	8.56	2.61	**
Non-verbal Communicative Pain Behaviour – F	484	.78	4.50	2.23	34	.73	3.94	1.92	Ns
Verbal Communicative Pain Behaviour - F	486	.78	7.24	2.66	34	.81	6.18	2.93	*

* $p < .05$; ** $p < .005$; *** $p < .0001$

M = mother report, F = father report

Correlations

Pearson correlation coefficients among variables were first computed separately for the school sample and the clinical sample. Tests of difference between independent correlation coefficients (Cohen & Cohen, 1983; Preacher, 2002) revealed no significant differences between groups (all Fisher *z*-scores < |1.96|, ns), indicating that the patterns in the clinical sample were in the same direction and of similar magnitude as those of the school sample. Therefore, Pearson correlation coefficients are presented together for the school sample and the clinical sample in Table 2.

[2] Analyses that were restricted to a sample where both parents reported on the same child (which was the case for approximately 74% of the parents of children from the school sample and 54% of the parents of children from the clinical sample) revealed similar results as those obtained for the whole sample of parents. Restricting analyses to this sample, represented a decrease in power. Therefore, results are reported on the whole sample.

Of particular interest were the interrelationships between the children's self-reported pain catastrophizing and parental accounts of expressive dimensions of pain. Correlations between pain catastrophizing and paternal and maternal perception of their child's verbal and non-verbal communicative pain behaviours and protective pain behaviours of their child were significantly positive. Furthermore, statistically significant positive correlations were found for pain catastrophizing with self-reported pain verbalizations of the child. Correlation analyses also revealed positive associations between self-reported pain verbalizations of the child and paternal and maternal perceptions of all three pain behaviour subscales.

Table 2

Pearson correlation coefficients for all parent and child measures for the sample of schoolchildren and the sample of children with chronic or recurrent pain.

	2	3	4	5	6	7	8	9
1. Pain catastrophizing	.26***	.38***	.10*	.11**	.08*	.13**	.08(*)	.12**
2.Child's Pain Verbalizations	---	.10*	.09*	.08*	.14***	.10*	.07	.10*
3. Pain intensity		---	.07*	.07(*)	.07(*)	-.02	.00	-.04
4. Protective Pain Behaviour – M			---	.47***	.38***	.35***	.26***	.23***
5.Non-verbal Communicative Pain Behaviour- M				---	.53***	.26***	.45***	.30***
6.Verbal Communicative Pain Behaviour – M					---	.24***	.28***	.43***
7. Protective Pain Behaviour– F						---	.57***	.46***
8.Non-verbal Communicative Pain Behaviour– F							---	.54***
9.Verbal Communicative Pain Behaviour - F								---

(*) p = .09 * $p < .05$; ** $p < .005$; *** $p < .0001$

M = mother report, F = father report

Explanatory value of pain catastrophizing

A series of hierarchical regression analyses was conducted to examine the contribution of pain catastrophizing to explaining the child's self-reported tendency to verbally share their pain experience with others and to explaining pain expressiveness as rated by the mother and by the father. Summaries of these analyses for self-reported expressiveness and parental reports of expressiveness are presented in Tables 3 and Table 4, respectively. In each analysis, the child's gender (boys coded as 0, girls coded as 1) and age were entered in step 1 to control for possible effects of these sociodemographic variables. In the subsequent step, the child's mean pain

severity was entered. In the third step, group (school sample coded as 0, clinical sample coded as 1) was entered. In the fourth step, pain catastrophizing was entered. In addition, in the final step, the interaction term between catastrophizing and group was entered to investigate whether the effects of catastrophizing differed between the two samples. To reduce the effects of multicollinearity, continuous variables were centered (Aiken & West, 1991). All regression analyses indicated no significant interaction effects of catastrophizing × group (R^2Change < .002, ns), which indicates that the effect of pain catastrophizing upon the dependent variables did not differ between groups. For ease of reporting, results of the regression analyses are presented with pain catastrophizing entered in the final step. Variance-inflation factors of all seven regression analysis were small (range 1.03- 1.28) indicating that there was no problem of collinearity.

Value of pain catastrophizing in explaining the child's self-reported Pain Verbalizations

Regression analysis (see Table 3) indicated that the self-reported tendency of the child to verbalize pain to others was related to the child's gender (β = .22; t = 6.11; p < .0001), with girls verbally sharing their pain with others significantly more than boys. Also the child's group had a significant effect; children with chronic or recurrent pain talk significantly less about their pain to others than school children (β = -.17; t = -4.83; p < .0001). As expected, the child's pain catastrophizing (β = .24; t = 6.30; p < .0001) was significantly associated with the child's self-reported tendency to verbalize their pain to others.

Table 3

Hierarchical regression analysis predicting the child's self-reported tendency to verbalize their pain to others in school children and children with chronic or recurrent pain. Standardized betas from the last step in the analysis are displayed.

Criterion Variable	Step	Predictor	β	ΔR^2	*Adjusted* R^2
Child's Pain Verbalizations	1	Age	.06	.07***	.07
		Sex	.22***		
	2	Pain intensity	.00	.01*	.07
	3	Group	-.17***	.02***	.09
	4	Pain catastrophizing	.24***	.05***	.14

* p < .05; *** p <.0001

Value of pain catastrophizing in explaining parental perception of their child's pain expressiveness

The regression analysis (see Table 4) of maternal perception of protective pain behaviour revealed that only the child's group had a significant effect (β = .12; t = 3.18; p < .005); mothers of children with chronic or recurrent pain perceived their child as showing more *protective* pain

behaviour than mothers of school children. The analysis of maternal perception of *non verbal communicative* pain behaviour revealed that the child's age (β = -.16; t = -4.09; p < .0001) and the child's pain catastrophizing (β = .10; t = 2.34; p < .05) had a significant contribution. Mothers tended to perceive more *non-verbal communicative* pain behaviour in younger children and when the child was highly catastrophizing. The analysis of maternal perceptions of *verbal communicative* pain behaviour indicated that the child's group (β = -.18; t = -4.71; p < .0001) had a significant effect; mothers of children with chronic or recurrent pain perceived their child as showing less *verbal communicative* pain behaviour than mothers of school children. As expected, maternal ratings of *verbal communicative* pain behaviour was also significantly associated with the child's pain catastrophizing (β = .08; t = 1.98; p < .05).

The analysis of father's ratings of the child's *protective* pain behaviour revealed that, unlike mother's reports, the child's age (β = -.09; t = -2.03; p < .05) and the child's pain intensity (β = -.10; t = -2.13; p < .05) had a significant negative contribution; fathers reported less protective pain behaviour when the children were older and when the children reported greater levels of pain. However, similar to the analysis of maternal perceptions, fathers of children with chronic or recurrent pain also perceived their child as showing more *protective* pain behaviour than fathers of school children (β = .13; t = 2.89; p < .005). Further, but unlike mothers' reports, results revealed that the child's pain catastrophizing (β = .14, t = 2.89; p < .005) had a significant positive contribution in explaining paternal perceptions of *protective* pain behaviour of their child. Again similar to mother report, fathers' ratings of *non verbal communicative* pain behaviour was also significantly associated with the child's age (β = -.19; t = -4.25; p < .0001) and the child's pain catastrophizing (β = .10; t = 2.00; p < .05); fathers tended to perceive more non-verbal communicative pain behaviour when the child was younger and when the child was highly catastrophizing. The analysis of the child's *verbal communicative* pain behaviour as rated by the father revealed that, unlike mothers' reports, the child's age (β = -.10; t = -2.14; p < .05) and the child's pain intensity (β = -.10; t = -2.05; p < .05) had a significant contribution; the older the child and the more pain the child reported, the less did fathers report *verbal communicative* pain behaviour in their child. Like mothers, fathers of children with chronic or recurrent pain also perceived their child as showing less *verbal communicative* pain behaviour than fathers of school children (β = -.10 t = -2.17; p < .05). Similar to mother report as well, the child's pain catastrophizing (β = .18; t = 3.62; p < .0001) had a significant positive contribution in explaining *verbal communicative* pain behaviour as rated by the father.

Table 4

Hierarchical regression analysis predicting the child's protective pain behaviour, non-verbal and verbal communicative pain behaviour in school children and children with chronic or recurrent pain as rated by the mother and the father. Standardized betas from the last step in the analyses are displayed.

			Mother			Father		
Criterion variable	Step	Predictor	*β*	*R²Δ*	*Adj R²*	*β*	*R²Δ*	*Adj R²*
Protective PB	1	Age	-.02	.00	-.00	-.09*	.01	.00
		Sex	.00			.01		
	2	Pain intensity	.04	.01	.00	-.10*	.00	.00
	3	Group	.12**	.02**	.02	.13**	.02**	.02
	4	Catastrophizing	.06	.00	.02	.14**	.02**	.03
Non-verbal communicative PB	1	Age	-.16***	.03***	.03	-.19***	.04***	.04
		Sex	-.04			.03		
	2	Pain intensity	.03	.00	.03	-.04	.00	.04
	3	Group	-.03	.00	.03	-.04	.00	.03
	4	Catastrophizing	.10*	.01*	.03	.10*	.01*	.04
Verbal communicative PB	1	Age	-.05	.01	.01	-.10*	.02*	.01
		Sex	.02			.01		
	2	Pain intensity	.05	.00	.01	-.10*	.00	.01
	3	Group	-.18***	.03***	.04	-.10*	.01	.01
	4	Catastrophizing	.08*	.01*	.04	.18***	.02***	.04

* < .05, ** p <.005 *** p < .0001

PB= Pain Behaviour

DISCUSSION

This study investigated the expressive dimensions of pain catastrophizing in school children and in children with chronic or recurrent pain. Overall, our results supported the position that pain catastrophizing has interpersonal consequences. Results can be readily summarized. First, pain catastrophizing was associated with a higher self-reported tendency of the child to verbally share their pain experience with others, beyond the effects of gender, age and experienced pain intensity. Second, and complementing with the previous finding, paternal and maternal perceptions of the verbal and non-verbal *communicative* pain behaviour of their children was uniquely related to pain catastrophizing. In addition, but only for fathers, pain catastrophizing was uniquely positively associated with the expression of *protective* pain behaviours. Third, the role of pain catastrophizing in explaining expressive behaviour as reported by the child and as rated by both parents did not differ between the school children and children with recurrent and chronic pain. Fourth, there were some marked differences between school children and the clinical sample. Children of the clinical sample experienced more severe pain, more pain catastrophizing, more protective pain behaviour, but fewer verbal communications about their pain.

These findings extend and further corroborate the findings of the adult literature that higher levels of catastrophizing are associated with a more expressive orientation in dealing with pain (Keefe et al., 2003; Sullivan, Adams, & Sullivan, 2004; Sullivan et al., 2006b). Children who engage in high levels of catastrophizing consistently report to verbally share their pain experience with others and are perceived as communicating their distress both verbally and nonverbally more than children who do not experience high levels of catastrophizing. The consistent finding that the child's catastrophizing impacts upon both parental accounts of *communicative* pain behaviour may indicate that children with high levels of catastrophizing not only feel threatened and helpless but are perceived as such by others. The finding that fathers also perceived more *protective* pain behaviours when their child was highly catastrophizing was not anticipated. These different perceptions may reflect different priorities of parents in caregiving (Phares, Lopez, Fields, Kamboukos, & Duhig, 2005). Mothers may perceive their catastrophizing children as more helpless, and may promote autonomy and independence to a lesser degree than fathers. Fathers may have a different focus, and may be inclined to attend to protective actions as a means of promoting self-management and autonomy of the child (Seiffge-Krenke, 2002; Walker & Zeman, 1992).

Although the findings suggest that children with higher levels of catastrophizing are more dependent upon the care available through others, questions remain about what types of parental responses are associated with high catastrophizers' pain expression. Adult studies indicate others' reactions might be adverse (Keefe et al., 2003; Lackner & Gurtman, 2003) as well as positive (Giardino, Jensen, Turner, Ehde, & Cardenas, 2003), with differential effects partly explained by the duration the person has suffered from pain (Buenaver, Edwards, & Haythornthwaite, 2007; Cano, 2004). Pain catastrophizing evokes solicitous responses from

others, but only for pain of short duration. For long lasting pain, the relationship reverses. Thus, pain catastrophizers' heightened pain expression might become, *over time*, a source of distress for caregivers, resulting in punitive or other negative consequences. This may explain the finding that children in the clinical sample catastrophized more than the school sample children, yet reported verbalizing their pain to others to a lesser extent and were also perceived as less talkative about their pain by both parents. When pain becomes chronic, parental responses may transform. Parents might seek to avoid the distress repeated exposure to their child's pain expression creates (Crombez & Eccleston, 2002). Alternatively, parents of children with long lasting pain may become habituated and perhaps inured or insensitive to their child's pain expression. Parents also may choose to focus upon non-painful/well behaviour to encourage healthy development. On the other hand, the identification of pain as signifying clinically important issues for the children and provision of care for the problem might have diminished the range of care seeking in which they purposefully engaged. It also remains plausible that novelty of the pain stimulus and the associated greater attentional interruption, which is less common in chronic pain samples, may account for this finding (Eccleston & Crombez, 1999). Finally, children might also, intentionally or unintentionally, suppress expression of pain because they want to present themselves as competent and not different from healthy peers (see Morley, Doyle, & Beese, 2000) or because they want to avoid negative social consequences (Larochette, Chambers, & Craig, 2006). The latter may become pronounced in children who are suffering pain for longer durations ánd are highly catastrophizing. (see also Cano, 2004).

There were also some gender and age effects upon pain expression. Gender differences indicated that girls reported higher levels of verbalizing their pain to others than boys, a finding consistent with earlier observations (Keogh & Eccleston, 2006; Unruh, 1996); but the girls were not perceived as more pain expressive for any of the three types of pain behaviour, by either their mothers or fathers. Possibly, gender differences in verbalizing pain to others might be especially pronounced in peer interaction, but less so in child-parent interactions. The measures of pain expression, however, were sensitive to other subtle differences among children. Age impacted upon parental ratings of their child's pain expressiveness, but not upon the child's self-reported tendency to verbalize pain to others. Mothers of older children rated their child as expressing less non-verbal communicative pain behaviour than mothers of younger children. Notably, fathers of older children perceived their child as being less pain expressive for all three types of pain behaviour. Possibly, parents' ratings, and in particular those of the father, might reflect their social/cultural expectancies towards pain expression of their child (Unruh, 1996).

Overall, our findings emphasize the importance of recognizing that several dimensions of pain expression respond differently to variations in thinking and situational demands—they serve -not necessarily with a conscious intent- different functions. *Verbal* reports provide details about painful experience, but are subject to response bias. *Non-verbal communicative* pain displays, are less subject to misrepresentation (Hadjistavropolous & Craig, 2002; Poole & Craig, 1992); hence, they appear particularly powerful in signifying pain to others. The least discrepancy between an observer's and a suffering person's pain ratings occurs when observers

have access to both the person's face and verbal reports (Kappesser, Williams, & Prkachin, 2006). Protective pain behaviours may also influence judgements of credibility even though their role as a cue for others to infer pain appears largely to be secondary (Sullivan et al., 2006a); they differ from communicative pain behaviours as they more immediately and actively control pain experience (Craig, 2004). Whereas *protective* pain behaviours might indicate that one is making efforts to take care of oneself, *communicative* pain behaviours signal a clear need for help. Consequently, communicative pain displays, and in particular pain verbalizations as indicated by the findings of this study, might be more likely to be reinforced by social contingencies. Protective pain behaviours may vary primarily in their effect on pain reduction (Sullivan et al., 2006a). Our finding that children of the clinical sample show higher levels of protective pain behaviours compared with children of the school sample may be a reflection of higher levels of pain experienced by those of the clinical sample and the usual pattern of pain motivating behaviour capable of limiting pain experience.

A number of limitations of the study deserve consideration. First, findings were based on cross-sectional and correlational data, and, hence, do not indicate causal effects. Observational studies are needed further to investigate both expressive features of pain catastrophizing and its reception by others. Secondly, average levels of pain catastrophizing and pain intensity were low for both samples in comparison with mean levels reported in other studies (Crombez et al., 2003; Vervoort, Goubert, Eccleston, Bijttebier, & Crombez, 2006). Further research is needed to establish whether the results generalize to samples with more severe pain. Third, the significant differences between the clinical sample and the school sample were of medium effect sizes. Replication of the study is needed on larger clinical paediatric pain samples to further investigate generalizability of the findings. Fourth, as the Pain Expression Scale was used for the first time, further research is needed to investigate the construct and predictive validity of the scale. Finally, the effects of the child's pain catastrophizing upon parental perceptions of pain expression were relatively small, leaving considerable variance unexplained. Nevertheless, the use of multi-source data, which is particularly important when conducting correlational/regression-oriented research, was a major strength of this study as it allows one to examine associations between predictors and outcomes that do not share common source variance (Holmbeck, Li, Schurman, Friedman, & Coakley, 2002). The use of multiple informant perspectives revealed a comparable impact of pain catastrophizing upon diverse outcome measures, contributing to the robustness of findings. Therefore, even with low explained variance rates, our findings are compelling and attest to the importance of transactional perspectives on pain that include both intrapersonal and interpersonal factors intersecting in determining pain experience and expression (Goubert et al., 2005).

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CHAPTER 4

EXPRESSIVE DIMENSIONS OF PAIN CATASTROPHIZING: AN OBSERVATIONAL STUDY IN ADOLESCENTS WITH CHRONIC PAIN

ABSTRACT

The present study investigated the relationship between pain catastrophizing in adolescents suffering chronic pain (n = 38) and the extent to which they engaged in different types of pain behaviours, i.e. *communicative* pain behaviours and *protective* pain behaviours. Adolescents were observed on video performing a 2 Minute Walk Test. Both facial pain expression and protective pain behaviours were coded on videotape. Adolescent's verbalizations about the 2MWT were rated by their parent. Analyses revealed that higher levels of catastrophic thinking about pain were associated with higher levels of communicative pain behaviours, but not with protective pain behaviours. Specifically, higher levels of catastrophizing were associated with both higher levels of facial pain expressions and higher levels of verbalizations about their pain experience, beyond the effects of age, gender, pain duration and pain intensity. Protective pain behaviours did not vary with the adolescents' level of pain catastrophizing, but varied closely with characteristics of the pain. The findings of the present study further corroborate a functional distinctiveness of different types of pain behaviours. Results are discussed in terms of the underlying processes linking (1) catastrophizing to communicative pain behaviours and (2) pain to protective pain behaviours.

INTRODUCTION

Pain catastrophizing, defined as a negative emotional and cognitive response to pain that includes elements of magnification, helplessness and rumination (Sullivan, Bishop, & Pivik, 1995), has increasingly been recognized as an important construct in understanding pain experience. Until recently, catastrophic thinking about pain and its effects upon pain-related outcomes has been investigated from a predominantly intra-individual perspective (see e.g., Goubert, Crombez, & Van Damme, 2004; Sullivan, Stanish, Waite, Sullivan, & Tripp, 1998). For example, considerable research has indicated a heightened association between pain catastrophizing and deleterious outcomes such as intensified pain, emotional distress and disability, both in adults and in children (Crombez et al., 2003; Sullivan et al., 2001; Goubert et al., 2004; Vervoort, Goubert, Eccleston, Bijttebier, & Crombez 2006). Catastrophizing, however, may also have important interpersonal consequences. It has been suggested that high pain catastrophizers seek assistance and care from others because they focus on their pain, experience their pain as threatening, and feel helpless in dealing with their pain (Sullivan et al., 2001). Pain expression has been discussed as the vehicle through which high catastrophizers attract the attention of others and promote others' proximity and care (Sullivan, Adams, & Sullivan, 2004; Sullivan, Martell, Tripp, Savard, & Crombez,, 2006a).

Pain behaviour, however, encompasses various patterns of verbal and non-verbal activity that may provide the means whereby pain is communicated to others (Prkachin & Craig, 1995). Pain behaviours have been discussed in terms of their protective function and their communication function (Craig, Prkachin, & Grunau, 2001; Hadjistavropolous & Craig, 2002; Sullivan et al., 2006b; Williams, 2002; Williams & Craig, 2006). The facial display of pain and verbalizations about the pain are supposed to have a primary *communicative* intent whereas other behaviours such as guarding, holding or rubbing, might primarily serve an immediate *protective* function by minimizing the pain or protecting the body from further harm (Sullivan et al., 2006b; Vervoort et al., 2008; Willams & Craig, 2006). Although the latter may also be informative for others to infer pain, numerous studies have indicated communicative pain behaviours, in particular the facial display of pain, to be most powerful in signifying pain to others (Hadjistavropolous, Craig, Grunau, Whitfield, 1997; Sullivan et al., 2006a) and instigate other's help and care (Williams, 2002). Hence, catastrophizer's heightened social communication of pain might be mainly due to an engagement in higher levels of communicative pain behaviours, rather than protective pain behaviours (Sullivan et al., 2004; 2006a).

Communicative processes may be particularly important in childhood. Children are highly dependent upon adult, and in particular parent, attention and care, and expressions of pain and distress are powerful signals of the need for attention (Chambers, 2003). To date, support for a heightened association between pain catastrophizing, pain behaviours and other's responses has come primarily from studies in adults (Keefe et al., 2003; Sullivan et al., 2004; 2006a). Few available findings in children, however, point in the same direction: high catastrophizing

children appear to have a more expressive orientation in dealing with pain (Bédard, Reid, McGrath, & Chambers; 1996; Vervoort et al., 2008). Yet, to our knowledge, findings in children are either based on self-report (Vervoort et al., 2008) and/ or use a single or undifferentiated measure of pain expression (Bédard et al., 1996; Vervoort et al., in press).

The aim of the present study was to investigate the role of pain catastrophizing in explaining different dimensions of pain expression in adolescents suffering chronic pain. Using an observational design in which adolescents were videotaped while performing a daily pain eliciting task, we investigated whether higher levels of pain catastrophizing in the adolescent are associated with higher levels of pain expression. Specifically, we explored whether different types of pain behaviour (i.e. communicative pain behaviours and protective pain behaviours) respond differently to variations in catastrophic thinking about pain.

METHOD

Participants

Adolescents with chronic pain were recruited from a residential UK multidisciplinary Pain Management Clinic. All adolescents were accompanied by an adult who was identified as a primary caregiver who adopted a parenting role. During a period of approximately one year, adolescents entering a pain management program and their primary caregiver were asked to participate. Adolescents were eligible to participate if they (1) did not suffer any significant psychiatric disorders and (2) were able to complete a 2 minute walk test without needing assistance from another person. Of the 11 programs delivered at the pain management clinic during the time of the study, adolescents of 3 programs were not invited to participate due to reconsideration of the time needed to extend ethical approval for this study. A total of 42 pairs of adolescents and their primary caregiver were approached and invited to participate in the study. Of these, 3 adolescents declined participation stating reluctance to be videotaped as the reason. Of the 39 adolescents who consented, 1 adolescent failed to complete the 2 Minute Walk Test. This resulted in a final sample of 38 adolescents (9 boys, 29 girls; mean age = 15.74 years, *SD* = 1.82, age range from 10.92 years to 19.08 years). Adolescents with chronic pain were classified according to an adolescent chronic pain classification scheme (Malleson & Clinch, 2003). Of the 38 adolescents, 23.7% had a diagnosis of Hypermobility (*n* = 9), 18.4% had Chronic Back Pain (*n* = 7), 15.8% had Reflex Sympathetic Dystrophy (*n* = 6), and 13.2% had Chronic Abdominal Pain (*n* = 5). The mean duration of the pain was 45.29 months (*SD*= 39.27 months; range 5 – 157 months).

Overall, 34 adolescents were accompanied by the mother, 4 by the father. Of the 38 adolescents participating, 36 primary caregivers (32 mothers, 4 fathers) also participated in the present study. Primary caregiver' participation included watching the videotape of their child performing the 2MWT and responding to some questions on their own and their child's experience. Refusal to participate was due to not wanting to see their child in distress. The mean

age of the mothers and the fathers was, respectively, 45.28 years (*SD* = 5.49) and 48.25 years (*SD* = 7.23). The majority of the parents (78.9%) were married or co-habiting.

The protocol of this study received full ethical approval from the UK National Health Service Ethics Committee.

Pain task

All adolescents were asked to perform a two-minute walk test (2MWT) at the beginning of the programme. The 2MWT is a measure of functional exercise capacity (Geiger et al., 2007; Taqi et al., 2006) that allows examination of the adolescent's engagement in a variety of pain behaviours. For chronic pain patients, a routine daily task, such as walking, requires movement that is usually sufficient to increase pain and to elicit pain behaviour (Prkachin, Schultz, Berkowitz, Hughes, & Hunt, 2002). Adolescents were requested to walk as fast as he/she can from one marker on the floor to a second marker ten meters away, and return, for a period of two minutes.

Instruments

Child measures

To measure the adolescents's *catastrophizing thoughts about pain* during the 2 MWT, we developed a situation-specific measure of the Pain Catastrophizing Scale for Children (PCS-C; Crombez et al., 2003; Sullivan et al., 1995). The PCS-C consists of 13 items describing different thoughts and feelings that children may experience when they are in pain and has shown to be a reliable and valid instrument in children from 9 to 15 years (Crombez et al., 2003). The PCS-C yields three subscale scores for rumination, magnification and helplessness. The situation-specific measure of the PCS-C used in this study consisted of 1 slightly adapted item for each subscale (PCS-C-state; Rumination: "Do you keep thinking about how much it might hurt during the two-minute walk test?"; Magnification: "Do you think that, because of the pain, something serious might happen during the 2 minute walk test?"; Helplessness: "Do you think that, because of the pain, you will not be able to stand it anymore during the 2 minute walk test?". The items of the PCS-C state were rated on an 11-point numerical rating scale (0 = 'not at all'; 10 = 'very much'). The total score on catastrophizing ranged from 0 to 30. In the present study, cronbach's alpha of the PCS-C state was high (α = .82).

Pain intensity was assessed using an 11-point scale with the endpoints 'no pain' (0) and 'a lot of pain' (10). Before completion of 2MWT adolescents were instructed to provide written ratings of how much pain they currently experienced; i.e. pain intensity prior to completion of the 2MWT ('*baseline pain'*). After completion of the 2MWT, adolescents were instructed to provide written ratings of how much pain they had experienced during the timed walk ('*experienced pain_2MWT'*).

To record the adolescent's *pain behaviour*, participants were videotaped throughout the procedure. A video camera was positioned at a standardized point behind the second floor

marker and afforded a view of the entire face and body of the adolescent. The procedure used for assessing pain behaviour was modelled after a procedure described by Sullivan et al. (The Pain Behaviour Coding Manual; PBCM; 2007) and incorporated descriptions of facial expressions of pain as defined in the Child Facial Coding Scale (CFCS; Breau et al., 2001; Chambers, McGrath, Gilbert, Craig, 1996; Gilbert et al., 1995). For the present study coders trained to competency using a pain behaviour coding manual specifically developed for the present study. Coders were also previously trained in use of the Child Facial Coding Scale. Each videotape was divided into different segments to code with the number of segments being equal to the number of times the adolescent walked the 10 meter distance from the first marker to the second marker; i.e. when the adolescent was walking with his/her face to the camera. Each of these segments was coded on the occurrence and/or intensity of pain behaviours. Given that verbalizations such as pain or disability talk did not occur during the 2MWT and other verbalizations such as groans or moans were hardly audible, only non-verbal pain behaviour was coded. Pain behaviours relevant to the 2MWT were classified as non-verbal communicative pain behaviours or protective pain behaviours. The following pain behaviours were classified as *protective* pain behaviours; (1) holding, rubbing or touching, (2) guarding, (3) stop walking/taking a rest, and (4) use of crutches. Facial pain expression was classified as *non-verbal communicative* pain behaviour. From videotape, a single trained coder rated pain behaviour for all participants. A second trained coder rated pain behaviour on a random sample of 20% of the participants to determine inter-rater reliability. The first and second category of protective pain behaviour (holding, rubbing, touching, and guarding) were coded for intensity (no action (0), slight action (1), distinct/maximal action (2)), the latter categories of protective pain behaviour (stop walking and use of crutches) were coded as absent or present (0 or 1). Facial pain expression was coded on intensity (0, 1, 2) and provided one global rating based on the occurrence and intensity of key facial pain expressions as identified in the CFCS (Chambers et al., 1996). Reliability was calculated according to the formula given by Ekman and Friesen (1978) which assesses the proportion of agreement on actions recorded by two coders relative to the total number of actions coded as occurring by each coder. (Breau et al., 2001; Gilbert et al., 1999). High interrater reliability was achieved for both the coding of facial pain expression (.77) and protective pain behaviour (.94; range .83- 1.00). To control for the difference in distance the adolescents walked, the total score on facial pain expression, respectively protective pain behaviour was divided by the number of segments coded (i.e. the number of times the adolescent the 10 meter distance from the first marker to the second marker), resulting in a score on facial pain expression ranging from 0.00 to 2.00 and protective pain behaviour ranging from 0.00 to 6.00.

Parent measures

To measure the *child's verbalizations about the pain task*, parents were requested to rate, 2 to 3 hours after the child performed the 2MWT, the extent to which the child had been talking to the parent about the 2 minute walk test (i.e. "how much has your child been talking to you about

the 2 Minute Walk Test ?"). Ratings were made on an 11-point scale with the endpoints 'not at all (0)' to 'very much (10)'. This index assessing verbal disclosure was used as a measure of *verbal communicative* pain behaviour.

Procedure

Adolescents entering a pain management programme were asked to participate in this study. All adolescents and their accompanying parent or guardian were approached by a research assistant or physiotherapist and provided with an information sheet. The purposes of the study was explained to participants as (1) "developing an observation scale that will enable physiotherapists to record quality of movement", (2) "to investigate the impact of children's pain upon the experience of parents" and (3) "to investigate the impact of psychological factors upon pain behaviour". Only the third objective was relevant to the present study. The first and second objectives of this study are the focus of other studies. Important however, is that for the second objective, the accompanying parent/guardian was required to watch the videotape of their child performing the 2MWT. Adolescents were informed about this before completion of the 2MWT.

Written informed consent was obtained from adolescents who expressed interest in taking part in this study. Written informed parental consent and adolescent assent was obtained for adolescents who were under eighteen years of age. As part of the standard assessment procedure, all adolescents and their primary caregiver were asked to (1) complete a battery of self-report questionnaires at the beginning of the programme and (2) adolescents were asked to complete the 2MWT in a corridor next to the room where adolescents and primary caregivers filled out the battery of questionnaires. Only those adolescents who agreed to participate in the study were videotaped during the 2MWT. Prior to the 2MWT, the adolescent (1) was informed that during a period of 2 minutes he/she has to walk as fast as he/she can from one marker on the floor to a second marker ten metres away and (2) requested to rate their current level of pain (i.e. baseline pain). The corridor where the 2MWT took place was closed to pedestrians during the test. To facilitate the patient to complete the test to their maximum ability standardized motivation instructions were given (at 30 seconds: 'as fast as you can', at 1 minute: '1 minute gone, 1 minute to go', at 1 minute 30 seconds 'only 30 seconds left', at 2 minute: 'stop, well done'). Use of walking aids was allowed, but patients were not encouraged to use them. To reduce the reactivity of pain behaviour observation (Keefe & Smith, 2002), the adolescent was provided with little information about the specific pain behaviours being coded and social interaction during the actual observation session was restricted to standardized instructions. After completion of the 2MWT, the adolescent was requested to rate how much pain they had experienced during the timed walk. They then returned to the room where they completed the standard battery of questionnaires. Two to three hours after the adolescent had performed the 2MWT, primary caregivers were requested by the research assistant to rate the extent to which their child had been talking to them about the 2MWT.

RESULTS

Descriptive statistics

Mean scores, standard deviations and correlations between measures are reported in Table 1. Adolescents experienced a significant increase in pain when performing the 2MWT; i.e. the mean level of baseline pain (M = 6.68; SD = 1.82) was significantly lower than the mean level of pain experienced during the 2MWT (M = 7.47; SD = 1.70; $t(37) = -5.05$, $p < .0001$). The mean level of catastrophizing measured prior to completion of the 2MWT was 8.08 (SD = 6.23; range 0 – 23). Adolescents walked on average 112.55 metres (SD = 52.42; range 10- 200). This mean performance is lower compared to findings in healthy children and adolescents (Geiger et al., 2007).

Correlations

Of particular interest for this study were the correlations between the child's pain catastrophizing, pain intensity and different dimensions of pain expression. (see Table 1). Pain catastrophizing was significantly positively associated with facial pain expression. In addition, there was also a positive, though trend-significant, association between catastrophizing and parental ratings of the child's verbalizations about the 2MWT. There were no other significant associations with the child's pain catastrophizing. Interestingly, pain indices (i.e. baseline pain, experienced pain, and pain duration) were most closely associated with protective pain behaviours, and less so with the indices of communicative pain behaviours. The child's level of pain intensity prior to and during the 2MWT was significantly positively associated with the level of protective pain behaviours. In addition, there was a marginally significant negative correlation between pain duration and both pain during the 2MWT and protective pain behaviours; i.e. longer pain duration is associated with lower levels of protective pain behaviours and lower levels of pain during the 2MWT. Facial pain expression was significantly positively correlated only with experienced pain during the 2MWT. Among the different pain behaviour indices, facial pain expression and protective pain behaviours were significantly positively correlated.

Table 1

Means (M), Standard deviations (SD) and Pearson correlation coefficients for all parent and child measures.

	M	*SD*	2	3	4	5	6	7	8
1. Pain catastrophizing	8.08	6.23	.10	.26	-.20	-.03	.39*	.31(*)	.07
2. Baseline pain	6.68	1.82	--	.85***	-.19	-.41*	.27	-.08	.37*
3. Experienced pain	7.47	1.70		--	-.29(*)	-.37*	.35*	-.02	.41*
4. Pain duration	45.29	39.27			--	.18	-.16	-.09	-.30(*)
5. Performance 2MWT	112.55	52.42				--	-.46**	-.29(*)	-.69***
6. Facial pain expression	.31	.54					--	.21	.48**
7. Child's verbalisations	1.08	1.86						--	.12
8.Protective pain behaviour	1.40	1.39							--

(*) p < .10, * p <. 05, ** p< .005, *** p < .0001

Value of pain catastrophizing in explaining different dimensions of pain behaviour

Three hierarchical regression analyses were conducted to examine the contribution of pain catastrophizing to explaining the child's facial pain expression (1) and protective pain behaviour (2) and to explaining the child's verbalizations about the 2MWT as rated by their parent (3). In each analysis, the child's gender (boys coded as 0, girls coded as 1) and age were entered in step 1 to control for possible effects of these sociodemographic variables. In the subsequent step, the child's mean pain duration was entered. In the third step, the child's experienced pain during the 2MWT was entered. In the final step, the child's pain catastrophizing was entered. A summary of these analyses is presented in Table 2. Variance-inflation factors of all three regression analyses were small (range 1.14-1.27) indicating that there was no problem of collinearity.

Value of pain catastrophizing in explaining the child's facial pain expression

The regression analysis with the child's facial pain expression as the dependent variable revealed that the child's gender had a significant contribution (β = -.34; p < .05), with boys showing more facial pain expression than girls. In line with expectations, the child's pain catastrophizing also had a significant contribution (β = .35; p < .05), independent from the child's age, gender, pain duration and experienced pain during the 2MWT. Higher levels of catastrophizing were associated with higher levels of facial pain expression during the 2MWT. There were no other significant contributions.

Value of pain catastrophizing in explaining the child's protective pain behaviour

The regression analysis with the child's protective pain behaviour as the dependent variable revealed that older children showed more protective pain behaviour than younger children (β = .33; p < .05). Pain duration had a significant contribution (β = -.33; p < .05) with longer pain durations being associated with lower levels of protective pain behaviours. In addition, pain

intensity also had a significant contribution (β = .32; p < .05); adolescents engaged in higher levels of protective pain behaviours when pain intensity during the 2MWT was higher. There was no significant effect of pain catastrophizing upon the display of protective pain behaviours (β = -.01, ns).

Value of pain catastrophizing in explaining the child's verbalizations about the 2MWT

The regression analysis with parental ratings of the child's verbalizations about the 2MWT as the dependent variable revealed that age had a significant contribution (β = .39; p < .05); parents of older children rated their child's verbalizations higher than parents of younger children. Pain catastrophizing also had a significant contribution (β = .42; p < .05), independent from the child's age, gender, pain duration and experienced pain intensity. Higher levels of catastrophizing were associated with higher parental ratings of child verbalizations about the 2MWT.

Table 2

Hierarchical regression analysis predicting the child's pain expression. Standardized betas from the last step in the analyses are displayed.

Criterion variable	Step	Predictor	β	R^2Change	Adj R^2
Facial pain expression	1	Sex	-.34*	.08	.02
		Age	.22		
	2	Pain duration	-.16	.07	.07
	3	Experienced pain	.22	.08	.14
	4	Catastrophizing	.35*	.11*	.23
Adolescent verbalizations	1	Sex	.19	.15	.10
		Age	.39*		
	2	Pain duration	-.05	.01	.08
	3	Experienced pain	-.13	.002	.05
	4	Catastrophizing	.42*	.16*	.20
Protective pain behaviour	1	Sex	-.25	.07	.02
		Age	.33*		
	2	Pain duration	-.33*	.16*	.17
	3	Experienced pain	.32*	.09*	.24
	4	Catastrophizing	-.01	.00	.22

* p < .05

DISCUSSION

The present study investigated the relationship between pain catastrophizing in adolescents suffering chronic pain and the extent to which they engaged in different types of pain behaviours, i.e. *communicative* pain behaviours and *protective* pain behaviours. Adolescents were observed on video performing a 2 Minute Walk Test. The findings of the present study can be readily summarized. First, higher levels of catastrophic thinking about pain were associated with higher levels of communicative pain behaviours, but not with protective pain behaviours. Specifically, higher levels of catastrophizing were associated with both higher levels of facial pain expressions and higher levels of verbalizations about their pain experience, beyond the effects of age, gender, pain duration and pain intensity. Second, unlike communicative pain behaviours, protective pain behaviours did not vary with the adolescents' level of pain catastrophizing. Protective pain behaviours varied more closely with characteristics of the pain; i.e. higher levels of self-reported pain intensity and shorter pain duration were both significantly associated with higher levels of protective pain behaviours, but not with communicative pain behaviours.

These findings are in line with previous research findings in adults (see e.g., Sullivan et al., 2004; Sullivan et al., 2006a) and preliminary findings in children (Vervoort et al., 2008): i.e. higher levels of pain catastrophizing are related to higher levels of communicative pain behaviours. However, associations with protective pain behaviours have also been reported (see e.g., Sullivan et al., 2006a). In the present study, high catastrophizing adolescents displayed higher levels of facial pain expression and were perceived by their parents as more talkative about their pain experience, but they did *not* engage in higher levels of protective pain behaviours. The latter category of pain behaviours was found to be dependent upon characteristics of the pain such as the duration of the pain and its experienced intensity. As such, the present findings emphasize the importance of recognizing that different types of pain behaviour respond differently to different determinants, and hence, should not be considered equivalent (Prkachin, 1986, Williams & Craig, 2006). In fact, the present findings further corroborate the idea that different categories of pain behaviours might serve different functions (Sullivan et al., 2006b; Vervoort et al., 2008). Facial expression of pain and verbalizations about the pain are two of the primary channels through which pain might be communicated to others (Hadjistavropolous & Craig, 2002). Protective pain behaviours more immediately control or minimize painful experiences (Craig et al., 2001). The distinctiveness of dissimilar categories of pain behaviours has previously been highlighted both by their variation with different determinants, as by their differential influence upon observers' responses. Specifically, communicative pain behaviours, in particular facial pain displays, have been found to be more pronounced when explicit social demands focus on communicating pain as opposed to when the focus is upon a neutral task (Sullivan et al., 2006b) to vary more closely with varying social contexts (Sullivan et al., 2004), to lead observers to attach high credibility to the sufferer's pain (Hadjistavropolous & Craig, 2002; Poole & Craig, 1992), and hence, instigate higher inferences

about the intensity of the sufferer's pain (Hadjistavropolous et al., 1997). In contrast, protective pain behaviours are not as variable in response to the different social contexts, but appear to vary more closely with the painful, physical demands of the task (Sullivan et al., 2006b). Their role as a cue for others to infer pain also appears to be secondary (Hadjistavropolous et al., 1997; Sullivan et al., 2006a). Communicative pain behaviours might therefore be more likely to be subject to social and environmental influences. Protective pain behaviours might more likely to be reinforced by its immediate effect upon pain reduction (Sullivan et al., 2006b; Vervoort et al., 2008). The present findings can also be interpreted in this light. Specifically, it has been suggested that not pain reduction, but interpersonal or caregiving goals are primary in high catastrophizers (Sullivan et al., 2001). For high catastrophizing children, who feel threatened and helpless in dealing with pain, obtaining empathy, reassurance and support per se may then be more important than the fact that it actually reduces or increases pain. Hence, for high catastrophizing children, heightened facial expression of pain and verbalizations about their pain to others might constitute the primary pathway to most effectively engage other's help and care. Differential processes might be invoked for the display of protective pain behaviours. Indeed, protective pain behaviours were not dependent upon the level of catastrophizing. Instead, they varied with characteristics of the pain; i.e. higher levels of pain and shorter pain duration were both associated with higher levels of protective pain behaviours. Following higher levels of pain were associated with shorter pain duration, associations between protective pain behaviours and these specific characteristics of the pain are comparable; i.e. more pain is more protective pain behaviour. Protective pain behaviours might be better understood within a context of self-management than within a context of help-seeking. After all, protective pain behaviours might be, at the short term, of obvious advantage to the sufferer in pain by minimizing pain (Sullivan et al., 2006b; Suls & Fletcher, 1985). For high catastrophizing individuals, engaging in higher levels of protective pain behaviours might be at odds with their primary need of dealing with pain and distress within an interpersonal context (see also Sullivan et al., 2004). Although protective pain behaviours appear to be less informative for others to infer pain, it is likely that they may augment or modify the message in the face (Williams, 2002). For example, they might reflect a sufferer's attempt to take care of the pain and carry on despite the pain. The relationship of facial pain expression to other types of pain behaviours, such as protective pain behaviours, and its combined impact upon other's inferences and responses, however, is relatively unexplored in the domain of pain.

Within the fear-avoidance (FA) model of pain, however, catastrophizer's heightened engagement in avoidance behaviours, has been repeatedly advanced as a valuable explanation by which catastrophizing, especially at the long term, may lead to exacerbation of pain and disability (Crombez, Vlaeyen, Heuts, & Lysens, 1999; Vlaeyen & Linton, 2000). In addition, some studies did reveal heightened associations between catastrophizing and protective pain behaviour (see e.g., Sullivan, Tripp, & Santor, 2000; Sullivan et al., 2006a). Inconsistencies in findings argue for a further refinement of the concept of pain behaviour. In particular, failure to find a relationship between the adolescent's level of catastrophizing and protective pain

behaviours here raises questions about whether protective pain behaviour, as assessed in the present study, differs from avoidance behaviour as defined in the FA model, and so may comprise distinct groups of pain behaviour (Keefe & Smith, 2002). There are reasons to assume this might indeed be the case. Engaging in certain types of pain behaviour is influenced by the value of expected outcomes, such as, for example, pain reduction (Kerns, Jensen, & Nielson, 2005). Protective pain behaviours, as defined in the present study, may serve this goal. Avoidance behaviours, however, occur in fearful *anticipation* of pain rather than in *response* to pain (Vlaeyen & Linton, 2000). Hence, these latter types of behaviour may be much more motivated by their effect upon reduction of fear. Heightened expression in pain catastrophizers may not primarily reflect attempts to reduce pain, but rather attempts to escape from and avoid perceived threat. Particularly interesting in this regard is a recent study of Tang et al. (2007) in a sample of adult patients with chronic back pain. In this study, patients' pain behaviour was assessed whilst performing two painful physical tasks. A distinction was made between overt pain behaviours and covert pain behaviours. The firmer category included behaviours identified by observers and comparable to protective behaviours assessed in the present study (e.g., guarding and rubbing). The latter category included behaviours that were identified by showing the patients their video playback and asking them to specify motivation for all behaviours displayed during the task. Drawing from the cognitive models of anxiety disorders, those pain behaviours that were described by patients as 'actions to *pre-emptively* minimize pain and to reduce anxiety' were defined as *safety-seeking* behaviours. Interestingly, protective pain behaviours and safety seeking behaviours showed substanstial overlap, yet, only safety-seeking behaviours correlated significantly with the patients' level of catastrophizing. Protective pain behaviours were more strongly associated with experienced pain during the task. Together with the present findings, these findings emphasize that a continuing refinement of pain behaviour is needed, both in terms of differential determinants as well as differential meanings for the sufferer, and its associated effects upon others.

Of further interest, there were also some gender and age effects upon pain expression. Gender differences indicated that boys engaged in higher levels of facial pain expression compared to girls. This finding was somewhat surprising. Most studies, even those that are not based upon child or caregiver perceptions but use observational designs, found pain expression to be higher in girls as compared to boys (Guinsberg et al., 2000; Keogh & Eccleston, 2006; Unruh, 1996; Vervoort et al, 2008) or failed to find a difference (Prkachin, 1992). A possible explanation, however, might be advanced for the present finding that boys were more facially expressive compared to girls. Given that boys use less socially oriented strategies in dealing with their pain compared to girls (Keogh & Eccleston, 2006), and/or parental influences possibly contributing to gender differences in help seeking and treatment attendance, it is likely that boys might wait much longer before seeking treatment for their pain. Once they do so, however, they might be in a much higher need for help compared to girls. Both the under-representation of boys in the present sample (9/39) as well as a longer pain duration in boys

compared to girls[1] corroborate these ideas. Age had also a significant effect upon pain expression with older adolescents expressing more protective pain behaviours and talking more about the pain task to their parents. This finding was, again surprising. Evidence from research based on both behavioural and self-report measures appears to indicate that younger children express and report more pain than older children and adolescents (Izard, Hembree, & Huebner, 1987; Stanford, Chambers, Craig, McGrath, & Cassidy, 2005). However, to the extent that protective pain behaviours might serve a self-management function, it is not unlikely that this particular type of pain behaviour might increase with age. In addition, higher levels of pain verbalizations with increasing age may reflect the increased cognitive capacities of the adolescent, in that they are more able to interpret their experience, and more likely to experience a more complex emotional reaction to pain including anger and anxiety. The latter may be particularly the case in adolescents suffering chronic pain (Eccleston, Crombez, Scotford, Clinch, & Connell, 2004).

A number of limitations of the study deserve consideration. First, coding of facial pain expression was based upon one global rating for the entire face. In addition, verbalizations of the child about the pain task were also assessed with one single item. Global as compared to more fine-grained analysis of the child's pain behaviour (e.g., coding of distinct facial pain expressions; Gilbert et al., 1999) are less reliable and decrease the statistical power to detect differences. Second, the pain behaviour coding procedure used in the present study was based upon a presumed functional distinctiveness of pain behaviours. Further refinement of pain behaviours and studies investigating its functional taxonomy are needed. Third, our sample was relatively small and comprised many more females than males, which might have impacted upon the results of this study. Finally, as we did not use a comparison group, it is not clear whether these results are specific to adolescents entering a multidisciplinary pain management program, or may be true for other clinical samples or the general population.

In spite of these limitations, the present findings indicate that different types of pain behaviours respond differently to variations in catastrophic thinking about pain and self-report of pain. In sum, these findings further corroborate a functional distinctiveness of different types of pain behaviours and emphasize that pain behaviour is more than an expression of subjective experience, but may also reflect the complexities of the interaction of individuals with the specifics of the social environments in which they find themselves.

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[1] Additional analyses indicated pain duration of boys (M = 65.44 months, SD = 39.04) tended to be longer compared to girls (M = 39.03 months, SD = 30.52, $t(36) = 1.82$, $p = .08$).

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CHAPTER 5

THE RELATIONSHIP BETWEEN HIGH CATASTROPHIZING CHILDREN'S INDISCRIMINATE DISPLAY OF PAIN AND PARENTAL JUDGMENT OF THEIR CHILD'S PAIN

ABSTRACT

The present study investigated the effect of the child's pain catastrophizing and self-reported pain upon the child's facial expression of pain and parental inferences of their child's pain. School children (n = 62) experienced pain by taking part in a cold water procedure. Analyses revealed that higher levels of pain intensity were associated with higher levels of facial pain expression. This effect, however, was only found for those children scoring low on the measure of catastrophizing. High catastrophizers' facial pain display did not vary with pain intensity: they expressed as much pain regardless of whether their reported pain intensity level is high or low. A similar pattern was obtained for parental pain inferences: child pain report was positively associated with parental pain inferences, but again, only for children with infrequent catastrophic thoughts about the pain. In addition, but only when the child's pain was low, parents of high catastrophizing children judged the pain of their child to be higher compared to low catastrophizing children. The latter was not reflected in the pattern of facial pain display. On the contrary, for high intensity pain, high catastrophizers' pain expression was even lower than that of low catastrophizing children. The implications of the findings are discussed in terms of the importance of assessing different dimensions of pain encoded in expression, different types of pain expression, and its differential effects upon others.

INTRODUCTION

Considerable research has indicated a heightened association between pain catastrophizing and deleterious pain-outcomes such as intensified pain and disability (Sullivan, Bishop, & Pivik, 1995; Sullivan et al., 2001; Vervoort, Goubert, Eccleston, Bijttebier, & Crombez, 2006). Recent conceptualisations of pain catastrophizing have also focussed on the *inter*personal nature of this construct. Specifically, high catastrophizers' appraisals of pain as extremely threatening and difficult to cope with may elicit attempts to seek support from others, for instance by overt display of pain (Sullivan et al., 2001). In support of this idea, previous findings in adults and children indicate that high catastrophizing individuals engage in higher levels of pain expression (see e.g.,, Sullivan, Adams, & Sullivan, 2004, Sullivan, Martel, Tripp, Savard, & Crombez, 2006a; Vervoort et al., 2008). These may attract the attention of others, and engage their help and care (Craig, 2004). In particular the facial display of pain is particularly powerful in signifying pain to others (Craig, 1998; Williams, 2002). Interestingly in this regard is that indices of non-verbal pain behaviour do not always correspond or only moderately correlate with self-reported pain (Hadjistavroplous & Craig, 2002; Labus, Keefe, & Jensen, 2003). This limits the degree to which observers can read and accurately infer others' self-report of pain. Accordingly, the often reported incongruent pain inferences (Chambers, Reid, Craig, McGrath, & Finley, 1998), which are generally assumed to be disadvantageous for the delivery of appropriate care for pain (Goubert et al., 2005; Prkachin, Solomon, & Ross, 2007), might be interpreted in this light. Given the importance of facial pain display for pain inferences ánd associated care, *but* its variable relationship with self-reported pain, investigating the extent to which, and under what conditions, facial pain display provides clear signals to self-reported pain states is a challenge.

Pain catastrophizing might be one important factor in understanding variable relationships between self-reported pain intensity and other indices of pain expression, e.g., facial display of pain. Indeed, the warning function of pain may be much more located in the cognitive- affective experience of threat and fear than in its sensory quality (Eccleston & Crombez, 1999; Van Damme, Crombez, & Eccleston, 2004). In fact, threat itself may be sufficient to interrupt attention and instigate pain behaviour (Crombez, Vlaeyen, Heuts, Lysens, 1999; Eccleston & Crombez, 1999). As catastrophizing is essentially about threat (Sullivan et al., 1995), the experience of pain itself may be sufficient for high catastrophizers to engage in higher levels of pain display. Accordingly, for high catastrophizing individuals, observers' pain inferences might be higher, though not necessarily more congruent with the individuals self-reported pain (see also Sullivan et al., 2006a). For low catastrophizers, one might reasonably expect that pain intensity must achieve a certain level before the facial display of pain will be evident (Prkachin & Craig, 1995).

Given the significant role of pain catastrophizing in children (Crombez et al., 2003; Vervoort et al., 2006), and the importance of parental responses for the child's pain experience (Chambers, 2003), the relationship between self-reported pain, catastrophizing, the facial

expression of pain and parental pain inferences was investigated in a sample of school children and their parents. Specifically, we expected (1) that levels of self-reported pain intensity would be positively associated with pain expression scores, in particular when catastrophizing about pain is low, but (2) that high catastrophizing children would show generally higher levels of facial pain expression compared to low catastrophizing children. In addition, (3) we explored whether the expected impact of the child's reported pain intensity and catastrophizing upon the child's facial display of pain is reflected in parental pain inferences.

METHOD

Participants

Participants were recruited from a larger sample of school children and their parents (n = 660) who had participated in a questionnaire study that took place approximately 1 year prior to this study (see Vervoort et al., 2008). Only children and parents who had given consent to be re-contacted, and who were not invited for participation in another study (see Vervoort et al., in press) were approached (n = 343). Exclusion criteria for this study included: (1) recurrent or chronic pain, (2) developmental delay, and (3) inability of both child and parent to speak and write Dutch. A weighted random sampling procedure was used (see Herzog, 1996) with an (1) equal proportion of boys and girls and (2) with an equal age distribution. Using this weighted procedure, 91 of the 343 parent child dyads were randomly selected and contacted. Of these, 64 children and parents, (n = 70.33%) agreed to participate. The main reasons mentioned by parents for non-participation were heavy work demands, or having made other plans (e.g., holiday). Participants were excluded from data analysis when they withdraw participation before the pain task (i.e. 3 minute cold water task) was completed. This was the case for two children. The final sample entering the analysis consisted of 62 school children (32 boys and 30 girls) and one of their parents (12 fathers and 50 mothers). Children ranged in age from 9.25 years to 15.50 years (M = 12.46 years; SD = 1.72). One-tenth (11.1%) of the children (n = 7) were recruited from the fifth grade, 15.9% (n = 10) from the sixth grade, 14.3% (n = 9) from the seventh grade, 22.2% (n = 14) from the eight grade, 20.6% (n = 13) from the ninth grade, and 15.9 (n = 10) from the tenth grade. Parents ranged in age from 35 years to 54 years (M = 42.85 years, SD = 4.31). The majority of the parents (88.5%) were married or co-habiting. Almost two-thirds (59%) had had higher education (beyond the age of 18 years). All participants were Caucasians. Ethical approval was obtained through the Ethics Committee of the Faculty of Psychology and Educational Sciences of Ghent University, Belgium.

Apparatus

A cold pressor apparatus was used as an experimental technique to induce pain in the children. The cold pressor device consisted of a commercially manufactured electronic cooler

measuring 35 cm wide, 60 cm long, and 45 cm high. There was a round opening in the lid (12 cm by 12 cm) through which children were instructed to lower their left hand up to just above the wrist in the tank with cooled water during three minutes. Temperature of the water was maintained at 10°C (+/-1°C) and was circulated continuously by a pump to prevent local warming. The cold pressor apparatus is well suited for use with children (Von Baeyer, Piira, Chambers, Trapanotto, & Zeltzer, 2005) and the pain experienced is considered to be an analog for various naturally occurring acute pains (Chen, Dworkin, Haug, Gehrig, 1989). The cold pressor apparatus was placed upon a trolley adjustable in height to provide comfortable access to the water tank for children of different stature. A second tank was used where the water was maintained at 37°C (+/-1°C). Participants immersed their arm in this warm bath prior to the cold pressor task so as to ensure that all participants entered their arm into the cold water with a similar skin temperature.

Instruments

Child measures

To measure the child's *catastrophizing thoughts about pain*, we developed a situation-specific measure of the Pain Catastrophizing Scale for Children (PCS-C; Crombez et al., 2003). The PCS-C consists of 13 items describing different thoughts and feelings that children may experience when they were in pain and yields three subscale scores for rumination, magnification and helplessness. The PCS-C has shown to be a reliable and valid instrument in children from 9 to 15 years (Crombez et al., 2003). The situation-specific measure of the PCS-C used in this study consisted of 2 adapted items for each subscale (PCS-C-state; Rumination: "At this moment, to what extent do you keep thinking about how much pain you will experience during the test?"; Magnification: "At this moment, to what extent do you think that, because of the pain, something serious might happen to you?"; Helplessness: "At this moment, to what extent do you think you will not be able to endure the test because of the pain?". The items of the situation-specific PCS-C were rated on an 11-point numerical rating scale (0 = 'not at all'; 10 = 'very much'), and were completed before completion of the cold pressor task. The total score on catastrophizing ranged from 0 to 60. In the present study, cronbach's alpha of this measure was high (α = .83).

Pain intensity was assessed using an 11-point scale with the endpoints 'no pain' (0) and 'a lot of pain' (10). After completion of the cold pressor task, children were instructed to provide written ratings of how much pain they had experienced during the cold water task ('experienced pain').

Anxiety was assessed using an 11-point scale with the endpoints 'not anxious/nervous' (0) and 'very anxious/nervous' (10). Children were prompted to provide written ratings of their experienced anxiety (how anxious and/or nervous were you during this pressure?') after completion of the cold water task ('experienced anxiety').

Pain behaviour

Children's *facial activity* was recorded by use of a video camera. Pain behaviour was measured using the Child Facial Coding System (CFCS; Breau et al., 2001; Chambers, McGrath, Gilbert, & Craig, 1996; Gilbert et al., 1999). The CFCS is an observational rating system of 13 discrete facial actions (Brow lowering, squint, eye squeeze, nose wrinkle, nasolabial furrow, cheek raiser, upper lip raise, lip corner pull, vertical mouth stretch, horizontal mouth stretch, blink, flared nostril and open lips). The CFCS has shown good reliability and validity in coding children's facial pain expressions (Gilbert et al., 1999). From videotape, a single trained coder rated pain behaviour for all participants. A second trained coder rated pain behaviour on a random sample of 20% of the participants to determine inter-rater reliability. Ten facial actions were coded for intensity (no action (0), slight action (1), distinct/maximal action (2)), and three facial actions (blink, flared nostril, open lips) were coded as absent or present (0 or 1). These 13 facial actions were coded each second of the three minutes the child immersed the hand in the cold water. For the coding of the 13 facial actions per second, a user-friendly software program was developed by an IT specialist that enabled raters to view and re-view each second at a normal rate and at a rate of 1/10 of a second. Reliability was calculated according to the formula given by Ekman and Friesen (1978) which assesses the proportion of agreement on actions recorded by two coders relative to the total number of actions coded as occurring by each coder. (Breau et al., 2001; Gilbert et al., 1999). Acceptable interrater reliability was achieved for overall frequency (.77; range .64-.94) and intensity (.70; range .57-.94) (Breau et al., 2001; Gilbert et al., 1999). For each 10 second time period the child immersed his/her hand in the cold water, a mean score per second was calculated for each facial action. The mean scores of the 13 facial actions of the 18 subsequent 10 second time periods were summed to yield a total CFCS score. As 10 of the 13 facial actions were coded on frequency and intensity (0,1 or 2) and 3 were coded on frequency alone (0 or 1), the total CFCS scores ranged between 0 and 414.

Parent measures

To measure *parental estimates of the child's pain*, parents were provided with a rating form after the child completed the cold pressor task. Parental ratings of *experienced pain intensity* of the child was assessed using an 11-point scale with the endpoints 'no pain' (0) and 'a lot of pain' (10). Parents were instructed to provide written ratings of how much pain their child had experienced during the cold water task.

Procedure

Using a standard script, a research assistant contacted participants by telephone. Families showing interest in participating were asked whether the child could be accompanied by the principal caregiver of the family. This person was described as the person who spent most time with the child and who took care of most of the household chores. When both the child and

his/her primary caregiver agreed to participate, an appointment at the laboratory at Ghent University was scheduled. A letter confirming their appointment was sent to them.

Upon arrival at the lab, two experimenters accompanied the parent and the child to the test-room (see also Figure 1). One of the experimenters described the pain procedure to the parent and the child and showed them the cold pressor apparatus. Participants were told that the aim of the study was to examine how children and parents think and feel about the pain that children experience. They were also told that they could remove their arm from the water at any time, for any reason, or that they could withdraw from participation at any time. Written, informed consent was obtained from parents and written assent was obtained from children.

A second experimenter then accompanied the parent to an adjacent observation room in which the parent could observe the child. To make observation as unobtrusive as possible, the child did not see the parent during the experiment. In the test-room, a video camera was positioned in front of the child to record the child's pain behaviour during the pain procedure. The camera was connected with a television screen in the observer-room where the parent was able to observe the child's face during the 3 minute cold pressor task and the two minutes preceding the CPT (i.e. when the child immersed his/her hand in the tank with water at 37°C (+/-1°C). (See Figure 1 for a schematic representation of the setting). Children were aware that their parent was observing them during the pain task.

Before proceeding with the pain task, the child was requested to wash their hands and to remove jewellery or watches of the left hand/arm. Then, the procedure of the pain task was briefly repeated to the child; they were informed that they would be asked to keep their hand (1) in water at body temperature during 2 minutes and next (2) in the cold water tank for 3 minutes. Again, they were reminded of the possibility that they could remove their arm from the water at any moment. Children were then requested to fill out the questionnaire on catastrophizing thoughts about the cold water task. After answering these questions, the experimenter in the test-room signalled, using a two-way radio, to the experimenter in the observer-room to turn on the television screen on which the parent could observe the child.

In order to minimize uncontrolled audience effects, the experimenter took place on a chair left behind the child, did not have eye contact with the child, did not talk to the child during the 3 minute cold water task and the 2 minutes preceding (i.e. hand in water at 37°C (+/-1°C). The experimenter closely monitored compliance of the child with the study protocol. A chronometer was used to (1) precisely time the length of the warm water and cold water immersion and (2) to communicate to the child the beginning and the end of the warm water phase (first 'beep', respectively second 'beep'), the beginning and the end of the warm water phase (third 'beep' and fourth 'beep'). After completion of the 3 minute cold water task, the television screen on which the parent could observe the child was turned off. The experimenter in the test-room requested the child to report on their pain intensity during the pain task while the experimenter in the observer-room requested the parents to infer pain intensity of their child during the CPT. After completing the questions, parent-child dyads reunited in the test-room, were debriefed about the purpose of the study and remunerated 25€ for their participation.

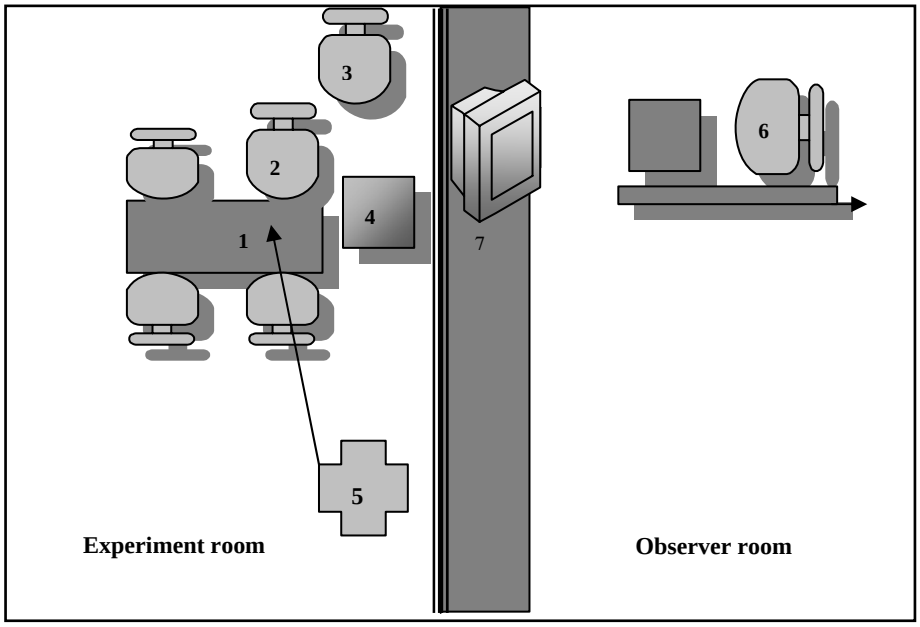

Figure 1: *Schematic representation of the experimental setting with the experimenter room and the observer room containing (1) place for instructions/debriefing (2) place where child was seated, (3) place were experimenter 1 was seated, (4) cold pressor apparatus, (5) camera position, (6) place where parent was seated, (7) TV screen.*

RESULTS

Descriptive statistics

Mean scores, standard deviations and correlations between measures are reported in Table 1. Children reported moderate levels of pain during the Cold Water Task (M = 4.11; SD = 2.44). In line with child report, parental estimates of the child's pain were also in the moderate range (M = 4.09; SD =2.32)[1]. There was no significant difference between child-reported pain and parental estimates of the child's pain ($t(62)$ = .062, ns; the mean difference score was -.02 (SD = 3.09). The discrepancy between parent and child pain ratings, i.e. the mean absolute deviation of parents' scores from children's scores was 2.64 (SD = 1.85). Children reported moderate levels of anxiety during the Cold Water Task (M = 3.21, SD = 2.35; range 0-8). The mean level of catastrophizing measured before the Cold Water Task was 16.80 (SD = 10.19; range 0 – 43). Kolmogorov-Smirnoff (KS) tests of normality indicated all variables were normally distributed, except the scores on facial pain expression (CFCS) (KS Z-score = 1.69, $p < .01$) and the score on

[1] Because of the small number of fathers (n = 12), analyses were not performed separately for mothers and fathers. In subsequent regression analyses, however, we controlled for the main effect of the participating parent (mother vs father).

child anxiety (*KS Z*-score = 1.43, p < .05), which were both skewed to the left. As the distribution of both variables differed moderately from normal, a square root transformation was performed for both variables (Tabachnik & Fidell, 2001). KS test of the transformed variables indicated no significant departure from normality (both *KS Z*-scores < 1.35, ns). In further analyses, these transformed variables were used.

Correlations

Of particular interest for this study were the correlations between the child's pain catastrophizing, pain expression, and child and parent pain intensity ratings and the child's anxiety (see Table 1). Pain catastrophizing was significantly positively associated with the child's level of experienced anxiety during the cold water test, but not with the child's pain intensity, facial pain expression, and parental pain inferences. However, the child's pain catastrophizing was significantly correlated with the discrepancy index, i.e. the absolute difference between the child's pain ratings and parental inferences. Correlation analysis indicated that higher levels of catastrophizing of the child were associated with higher levels of discrepancy or incongruence between the child's pain ratings and parent inferences. The child's pain intensity was not significantly correlated with the CFCS scores. Interestingly, however, the association between inferred pain (parental ratings of the child's pain) and the CFCS scores approached significance (p = .06), indicating that higher levels of facial pain expression of the child are associated with higher parental pain inferences.

In addition, no significant correlations with age of the child were found. There were also no significant gender differences, except for parental ratings of the pain of their child: parents rated the experienced pain intensity of girls higher than the pain intensity of boys ($t(62) = -2.00$, p = .05).

Table 1

Means (M), Standard deviations (SD) and Pearson correlation coefficients for all parent and child measures.

	M	*SD*	2	3	4	5	6
1. Pain catastrophizing child	16.80	10.19	.19	.17	.26*	.47***	-.17
2. Child's experienced pain – child report	4.11	2.44	--	.16	.07	.60***	.15
3. Child's experienced pain – parent report	4.09	2.32		--	.03	.18	.24(*)
4. Discrepancy index[1]	2.64	1.85			--	.002	-.16
5. Child's experienced anxiety	3.21	2.35				--	-.04
6. Facial pain expression child	24.45	28.20					--

[1] Absolute difference score child-parent pain rating

(*)p =.06, * p < .05,** p < .01 *** p < .0001

Pain intensity and facial pain expression: the moderating role of pain catastrophizing

A hierarchical regression analysis was conducted to investigate whether the child's pain catastrophizing moderated the relationship between the child's pain intensity and the child's pain expression (CFCS score). To test for pain catastrophizing as a moderator, it is necessary to enter the cross-product terms of pain intensity and pain catastrophizing in a separate block in a hierarchical regression analysis, following the entry of pain intensity and pain catastrophizing as first-order terms (Baron & Kenny, 1986). To reduce the effects of multicollinearity, continues variables were centered (Aiken & West, 1991). The child's gender (boys coded as 0, girls coded as 1) and age were entered in step 1 to control for possible effects of sociodemographic variables. In the second step, parental presence (mothers coded as 0, fathers coded as 1) were entered. To control for the specific effect of pain catastrophizing, the child's experienced anxiety, which was significantly correlated with pain catastrophizing, was entered in the third step. In the fourth step, the child's pain intensity and pain catastrophizing were entered. In the final step, the interaction term between pain intensity and pain catastrophizing was entered. The variance-inflation factors of the moderation analysis was acceptable (range 1.10 - 2.10), suggesting that there was no problem of multicollinearity. Statistically significant interaction was interpreted by plotting regression lines for high and low values of the moderator variable (Aiken & West, 1991; Holmbeck, 2002).

The analysis with facial pain expression (CFCS) as the dependent variable revealed no significant effects for age, gender, parent gender and child anxiety. The effect of experienced pain intensity of the child was significant (β =.30, $p < .05$); i.e. higher levels of pain of the child were associated with higher levels of facial pain expression. There was a negative, though not significant contribution of pain catastrophizing (β =-.20, ns). The interaction between pain intensity and pain catastrophizing reached significance (β = -.27, $p < .05$; ΔR^2=.07; Adjusted R^2 = .12), revealing that the association between pain intensity and pain expression was conditional on the values of the child's pain catastrophizing. To illustrate the pattern reflected in this statistically significant interaction term, we plotted regression lines for high (+1 *SD* above the mean) and low (-1 *SD* below the mean) values of the moderator variable (see Aiken & West, 1991; Holmbeck, 2002) (see Figure 2). Significance tests for both slopes showed that the slope for the Low Catastrophizing regression line was significant (β = .56, $\underline{p} < .01$), indicating that higher levels of pain intensity were associated with higher levels of facial pain expression, but only for children with low levels of catastrophizing. The slope for the High Catastrophizing regression line did not reach significance (β = .06, ns), indicating that higher levels of pain intensity are not associated with more facial pain expression when the child is highly catastrophizing. Additional analyses indicated that the effect of catastrophizing upon facial pain expression was positive, but non-significant, for lower levels of pain (β = .22, ns). Counter to expectations, for higher levels of pain, high catastrophizing children express significantly less pain than low catastrophizing children (β = -.63, $p < .05$).

Table 2

Hierarchical regression analysis predicting the child's facial pain expression and parental judgment of the child's pain. Standardized betas from the last step in the analyses are displayed.

Criterion variable	Step	Predictor	*β*	*R²Δ*	*R²*	*Adj R²*
Facial pain expression	1	Age	-.22	.06	.06	.03
		Sex	.15			
	2	Parent	.02	.00	.06	.001
	3	Child anxiety	-.21	.004	.06	-.004
	4	Pain catastrophizing	-.20	.10*	.16	.07
		Child pain	.30*			
	5	Pain catastrophizing ×Child pain	-.27*	.07*	.22	.12
Parental pain rating	1	Age	-.09	.07	.07	.04
		Sex	.18			
	2	Parent	-.08	.02	.09	.04
	3	Child anxiety	.002	.02	.11	.05
	4	Pain catastrophizing	.07	.02	.12	.03
		Child pain	.11			
	5	Pain catastrophizing ×Child pain	-.27*	.06*	.19	.08

* p < .05

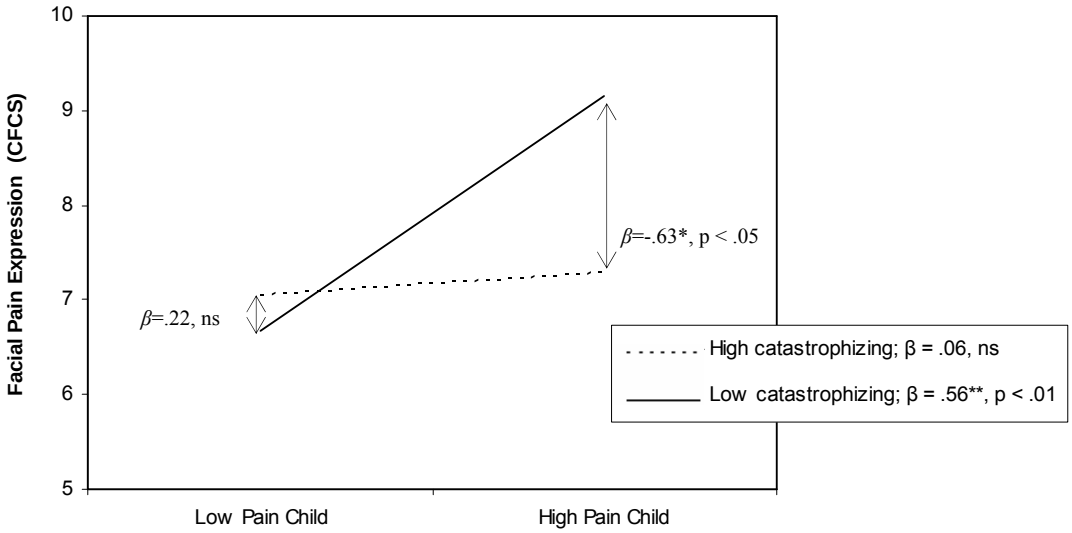

Figure 2: Regression lines for the relationship between the child's pain intensity and pain expression (CFCS score) during the Cold Pressor Task as moderated by Catastrophizing of the child. Standardized Beta's (β) are shown.

** p < .01, * p < .05

Children's pain catastrophizing and parental pain inferences

We further investigated whether the effect of the child's pain intensity × catastrophizing upon facial pain expression was reflected in a similar way in parental pain ratings; i.e whether the child's pain intensity was differentially associated with parental pain inferences depending on the level of catastrophizing of the child. A similar moderation analysis as above was performed with *parental pain rating* as dependent variable. The child's gender (boys coded as 0, girls coded as 1) and age were entered in the first step. Parental presence (mothers coded as 0, fathers coded as 1) was entered in the second step. The child's anxiety was entered in the third step. The child's pain intensity × catastrophizing was entered in the final step, following the entry of pain intensity and catastrophizing as first-order terms in the fourth step.

The analysis revealed that only the interaction between the child's pain intensity and level of catastrophizing had a significant effect (β = -.26, $\underline{p} < .05$; ΔR^2=.06; Adjusted R^2 = .08; see also Table 2), indicating that the association between pain intensity ratings of the child and parental pain inferences was conditional on values of the child's pain catastrophizing. To illustrate the pattern reflected in this significant interaction, we plotted regression lines for high (+1 *SD* above the mean) and low (-1 *SD* below the mean) values of the moderator variable (see Aiken and West, 1991; Holmbeck, 2002). These regression lines are shown in Figure 3. Findings were similar to the regression analysis upon facial pain display. The slope for the low catastrophizing children was significant, with higher levels of pain intensity of the child being positively associated with higher levels of parental pain inferences (β = .36, p < .05). For high catastrophizing children, the child's level of pain intensity was not significantly associated with parental pain inferences (β = -.13, ns). Additional analysis, however, revealed surprising findings, compared to the regression analyses upon facial pain display. Although catastrophizing of the child had no significant impact upon facial expression for low intensity pain (see moderation analysis in section 3.3), catastrophizing did have a significant positive impact upon parental pain ratings, only in case the child's pain intensity is low (β = .49, p < .05); i.e. parents of high catastrophizing children rated the pain of their child higher than parents of low catastrophizing children, but only when the child reported low intensity pain. The child's level of catastrophizing had a negative, though not significant impact upon parental pain inferences when the child's level of pain was high (β = -.34, ns).

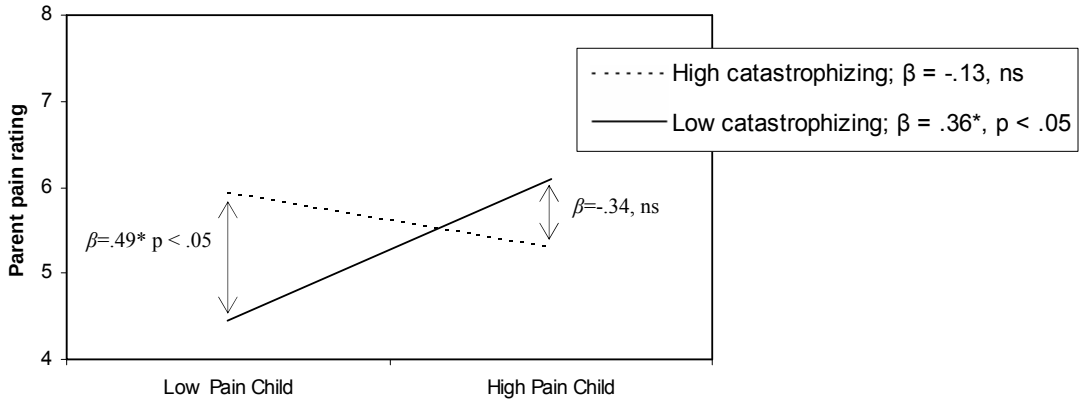

Figure 3: *Regression lines for the relationship between the child's pain intensity and parental pain inferences during the Cold Pressor Task as moderated by catastrophizing of the child. Standardized Beta's (β) are shown.*
* p < .05

DISCUSSION

The present study investigated the impact of childrens' reported pain intensity and pain catastrophizing upon the *facial expression of pain* in children taking part in a cold water test. We expected (1) that higher levels of pain intensity are associated with higher levels of facial display, in particular when the child is low catastrophizing, and (2) that children who highly catastrophize about pain would display higher levels of facial pain expression, independent of their level of pain. In addition (3) we explored whether parental ratings of the child's pain reflect the impact of pain intensity and catastrophizing upon the child's facial pain display. The findings can be readily summarized. First, higher levels of pain intensity were associated with higher levels of facial pain expression. As expected, this was only the case in children who reported low levels of catastrophic thinking about pain. High catastrophizing children indiscriminately expressed their pain; i.e. they expressed as much pain whether their pain intensity level is high or low. Second, but counter to our expectations and the results of previous studies in adults and children (Sullivan et al., 2006a; Vervoort et al., 2008), findings of the present study revealed that higher levels of catastrophizing did not contribute to higher levels of pain expression. For high intensity pain, high catastrophizers' pain display was even lower compared to low catastrophizers' pain display. Pain display of high catastrophizers did not differ from low catastrophizers when pain was low. Third, the above pattern, however, was only partially reflected in parental ratings of their child's pain. Parental pain ratings were positively associated with the child's report of pain, but only for children who reported low levels of catastrophic thinking about pain. Contrary to the pattern of facial pain display obtained in the present study, though in line with study expectations, higher levels of catastrophizing of the child contributed to higher parental ratings of the child's pain, but only in case the child's pain was low.

The findings of the present study are in line with the notion that self-report of pain and the expression of pain may be distinct phenomena providing different information (Hadjistavropolous & Craig, 2002). Both self-report and facial pain behaviour are both echoes of the pain experience. Yet, they do not always coincide (Labus et al., 2003). The present findings indicate that the extent to which pain is expressed is not merely a function of the pain reported. Instead, dimensions, other than the self-reported pain intensity, may be encoded in the facial display, and hence, are important in understanding the extent to which and when pain behaviour mirrors pain report. Facial expression appears to carry unique variance in pain but there is relatively little data on the extent to which the face encodes a particular component of the pain experience, such as pain intensity, meaning or affect (Williams, 2002) Understanding the meaning or determinants of various forms of pain expression and relationships among them, however, is important for the delivery of appropriate care: i.e. care tailored to the specific *needs* of the pain sufferer (Hadjistavropolous & Craig, 2002). As indicated by the findings of this study, pain catastrophizing might be one important factor in understanding the extent to which particular components of pain, such as self-reported intensity, are encoded. For low catastrophizing children, it appears that pain intensity must indeed achieve a certain level before it becomes evident in the face (Prkachin & Craig, 1995). In contrast, the indifferent pattern of pain expression in high catastrophizing children, suggests that for these children encoding of pain is much more dependent upon other dimensions. Specifically, for high catastrophizing children, the experience of pain in and of itself may be perceived as threatening and hard to deal with, and hence, be sufficient to instigate pain behaviour (Crombez et al., 1999; Eccleston & Crombez, 1999). Yet, the finding that catastrophizers did *not* express more pain in general argues, at first sight, against this thesis, and hence, renders findings more difficult to explain. In fact, and making it even more puzzling, high catastrophizers' pain display was even lower compared to that of low catastrophizing children for high-intensity pain.

The idea that high catastrophizing children are less congruent in the communication of their pain to others, might imply high catastrophizers' pain is poorly read by others, in particular when their pain is high. This assumption was only partially supported. In support of this, findings indicated that child pain report was positively associated with parental pain inferences, but only for children who reported low levels of catastrophic thoughts about the pain. For high catastrophizing children, parental pain ratings reflected the pattern of facial pain display: they did not vary with child-reported pain. Interestingly, however, parents of high catastrophizing children attributed more pain to their child compared to parents of low catastrophizing children, but only when child-reported pain was *low*. As such, it appears that study expectations are more reflected in the pattern of parental pain ratings but less so in the pattern of facial pain display of the child. Accordingly, it is plausible that high catastrophizing children engaged in a range of other behaviours that were not assessed within the present study, but may have served as a cue for parents to infer pain (Hadjistavropolous & Craig, 2002; Williams & Craig, 2006). In sum, the present findings suggest that high catastrophizing children indiscriminately display their pain, and are perceived as such by their parents. In addition, parental judgments of the child's

pain suggests that 'false alarms' may be higher in high catastrophizing children compared to children scoring low on the measure of catastrophizing.

The findings of this study are intriguing and raise several questions. Specifically, as the child's indiscriminate display of pain was perceived as such by their parents, questions can be raised about the impact this may have upon parental emotional and behavioural responses for the child's pain (Goubert et al., 2005). Desynchrony between self-report of pain and non-verbal (facial) expression may have implications for problems in the communication of pain (Barbee, Rowatt, & Cunningham, 1998; Pierce, Lakey, Sarason, Sararson, & Josehp, 1997). First, indiscriminate pain displays may give rise to frustration or distress on the part of the parent because of difficulties in reading the pain of their child. Catastrophizing in children may therefore not only elicit sympathetic and supportive parental responses, but also critical and frustrated parental responses (see e.g.,, Cano, 2004; Keefe et al., 2003). The latter may in fact be most influential in contributing to negative pain-related outcomes (Buenaver, Edwards, Haythornthwaite, 2007). Second, high catastrophizing children may also carry the risk of not receiving care when most needed; i.e. high catastrophizers' indiscriminate display of pain may lead to a familiarity bias on the part of the parent, thereby increasing the risk of the failure to respond to a new or serious need for care or help (Vervoort et al., in press). In fact, the present findings suggest that parents of high catastrophizing children may be most likely to be falsely alarmed by the pain of their child. Indeed, parents of high catastrophizing children rated their child's pain significantly higher compared to parents of low catastrophizing children, but only in case child-reported pain was *low*. Heightened parental attention and care for low levels of pain in their child may possibly further add to the aversiveness of pain and increase catastrophizer's vulnerability in dealing with pain (Walker et al., 2006). To date, the relationship between children's catastrophizing and parental responses, as well as the impact of these responses upon the child's pain experience and pain catastrophizing has not been investigated. A full understanding of the relationship between the child's catastrophizing and pain expression, however, requires taking into account the moderating impact of diverse social contingency patterns. Possibly, the specific history of parental responses for their child's pain, which might include positive but also negative responses (Buenaver et al., 2007) might shed light on why higher levels of catastrophizing *thoughts* were not associated with higher levels of facial pain *expression*.

There are some limitations of the present research to be considered. First, our sample consisted of school children and their parents. Second, this study was a lab-based study using an experimental pain stimulus. The results can be applied only with caution to clinical or naturally occurring pain. Further research is needed to replicate these findings and to examine the generalizability of the results to samples of children undergoing painful medical procedures or children suffering chronic or recurrent pain. Third, the effects of the child's pain catastrophizing were relatively small, leaving considerable variance unexplained. Appreciating communication of pain requires an understanding of expressive ánd receptive features of the communication process (Prkachin & Craig, 1995). Specific characteristics of the parent might influence

perception of pain in their child. For example, highly catastrophizing parents might be more likely to attend to their child's pain and to perceive more pain in their child (see Goubert, Vervoort, Cano, & Crombez, in press). Hence, they might be more likely to respond differently to their child's pain as well (Goubert, Vervoort, Sullivan, Verhoeven, & Crombez, in press). Future studies investigating the extent to which the child's catastrophizing and parental catastrophizing about their child's pain interact in their effect upon pain expression and pain perception might yield useful insights. Finally, some methodological issues should be taken into account when drawing interpretations from the present findings. In the present study, children were asked to immerse their arm in cold water for a period of three minutes. Previous studies using the CPT, however, have indicated facial pain display tends to decrease over time while pain intensity ratings increase (see e.g., Sullivan et al., 2006a). In the present study, additional analyses indicated that the child's facial pain display also decreased over time. Child and parent pain ratings, however, were assessed once. Although child and parent were asked to rate, after completion of the CPT, the mean pain intensity, it remains possible that pain intensity ratings of parent and child refer to dissimilar time periods, and hence, may have obscured some of the findings.

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CHAPTER 6

THE EFFECTS OF PARENTAL PRESENCE UPON THE FACIAL EXPRESSION OF PAIN: THE MODERATING ROLE OF CHILD PAIN CATASTROPHIZING[1]

ABSTRACT

This experiment investigated the effects of child catastrophic thinking and parental presence on the facial expressions of children when experiencing pain. School children experienced pressure pain in either one of two conditions: (1) when observed by a parent (n = 53 children and their parent), or (2) when observed by an adult stranger (n = 31 children). Analyses revealed that children showed more facial pain expression in the presence of their parent than in the presence of the stranger. This effect was, however, only found for children with infrequent catastrophic thoughts about pain. Children who have frequent catastrophic thoughts expressed high pain regardless of who they believed was observing them. Results are discussed in terms of the social consequences of pain catastrophizing, and the variables contributing to the expression or suppression of pain display in children and its impact upon others.

[1] Vervoort, T., Goubert, L., Eccleston, C., Verhoeven, K., De Clercq, A., Buysse, A. & Crombez, G. (in press). The effects of parental presence upon the facial expression of pain: The moderating role of child pain catastrophizing. *Pain.*

INTRODUCTION

Pain signals danger and promotes escape and avoidance from physical threat. Both functions are individually adaptive, increasing the chance of one's survival. An individual *expressing* pain may experience further benefit when that expression is followed by protective actions by observers (Craig, 2004). However, the extent to which pain is expressed is not simply a function of the pain experience (Hadjistavropoulos & Craig, 2002). The social context may be critical in explaining how and when pain is expressed. Disclosing pain may, indeed, have diverse social consequences, ranging from supportive or empathic responses to social withdrawal, punishment, or even exploitation of vulnerability (Williams, 2002). When negative responses to a display of pain are anticipated, suppression of pain expression might arise (Williams, 2002). Indeed, children as young as 9 years report being less likely to express pain in front of a peer than in the presence of their parent because they perceive peers to be less accepting of pain displays than parents (Zeman & Garber, 1996). In contrast, when believed to be in the presence of solicitous others, one might expect higher pain expression (Morley, Doyle, & Beese, 2000).

How social presence affects children's pain display is unclear. In this experiment we focus upon the effect of social presence on pain expression, and upon the extent to which its effects are moderated by a child's tendency to catastrophize about pain. Pain catastrophizing, defined as "an exaggerated negative orientation towards actual or anticipated pain experiences" (Sullivan, Bishop, & Pivik, 1995), is a major determinant of intrapersonal features of pain, including heightened pain intensity, distress and disability (Sullivan et al., 2001. Recently, Sullivan et al. (2001) argued that pain catastrophizing also has interpersonal features, i.e. those who catastrophize about pain seek social support by overt display of pain, because they feel threatened and helpless about their pain (see also Sullivan, Martel, Tripp, Savard, & Crombez, 2006). For those who catastrophize about pain, the presence of others may then function as a discriminative cue for the expression of pain. In line with this view, Sullivan, Adams, & Sullivan, (2004) found that adult patients who catastrophize about pain display pain behaviour for a longer duration when an observer is present. The observers were, in this case, unrelated to the person experiencing pain. It remains to be investigated whether one's pain display varies depending on the relational status of the observer. One might expect that pain expression will be most pronounced in the presence of significant others from whom support and assistance have been experienced on previous occasions.

Given the importance of parents in the socialization of the child's pain expression (Craig, Stanford, Fairbairn, & Chambers, 2006) and the influence of pain catastrophizing in children (Crombez et al., 2003), this experiment investigated the effects of parental presence and child pain catastrophizing upon the child's facial expression when the child experienced pressure pain. We expected that (1) children would show more facial pain expression in the presence of a parent than in presence of a stranger and (2) that this effect would be most pronounced for children who frequently catastrophize about pain.

METHOD

Participants

Participants were recruited from a larger sample of school children and their parents (n = 660) who had participated in a questionnaire study that took place approximately two months earlier (see Vervoort et al., in press). This original study cohort provided a unique sample to study the questions addressed here. Only children and parents who gave their consent to be re-contacted for an experimental study (n = 453) were approached. Children and their parents were eligible to participate if the child did not suffer from (1) a chronic illness including recurrent or chronic pain, (2) a developmental disorder, and (3) the child and parent were unable to speak and write Dutch. A weighted random sampling procedure was used (Herzog, 1996). From the total of 453 parent child dyads who consented, 110 parent child dyads, with an equal number of boys and girls and with an equal age distribution, were randomly selected and contacted. Of those contacted, 8.2 % (n = 9) met the exclusion criteria. Of the remaining 101 contacted children and parents, 87.1 % (n = 88) agreed to participate. Four children and their parents later withdrew because of illness of their child or other family responsibilities. The final sample to enter the analysis (response rate = 83.2 %) consisted of 84 children (40 boys, 44 girls) aged 9-15 years (M = 11.82 years, SD = 1.70) and one of their parents (71 mothers, 13 fathers). The majority of the children (59.5%; n = 50) was from the lower grades (grades 4 [n = 20], 5 [n = 15], and 6 [n = 25]). The remainder of the children was recruited from the higher grades (grades 7 [n = 13], 8 [n = 12], and 9 [n = 9]). Parents ranged in age from 33 to 55 years (M = 40.39 years, SD= 4.29). Most parents (81.2 %) were married or co-habiting. Two-thirds (66.7 %) had further education (beyond the age of 18 years). Children and their parents were compensated 25€ 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.

Apparatus

An electronic *algometer* (Somedic®) was used to induce pain in the children. This apparatus allows measurement of pressure thresholds and tolerances. It is often used for assessing pain in patients with fibromyalgia, tension headache and other muscular problems. Pressure was applied through a rubber disc with a surface of 1 cm^2 and was increased gradually for each participant. Pressure was induced on two predefined tender points of the non-dominant side of the child's body: at the suboccipital muscle insertion region (i.e. region in the neck), and at the anterior aspect of the interspaces between the transverse processes of C5-C7 (i.e. region on the shoulder) (Wolfe et al., 1990). These 2 tender points were selected because the experimenter could stay behind the child, and thus did not interfere with the videotaping of the child's facial pain expressions. The experimenter held the algometer against the skin of the child, and instructed the child to signal when he/she judged that the pressure had become painful. The algometer recorded the pressure value when the child communicated when they first

experienced pain. This value was the pain threshold. To administer pressure pain with varying intensity levels to the child, high and low levels of pressure were calculated by summing/subtracting 70kg/cm^2 of the individual pain thresholds for neck and shoulder. Pressure induced pain thresholds can be determined reliably with the algometer (Antonaci, Sand, & Lucas, 1998).

Measures

Catastrophic thinking about pain was assessed with the Dutch version of the *Pain Catastrophizing Scale for Children* (*PCS-C*) (Crombez et al., 2003). The PCS-C was completed by the child approximately 2 months in advance as part of a larger questionnaire study (see Vervoort et al., in press). This instrument is an adaptation of the adult Pain Catastrophizing Scale (Sullivan et al., 1995). The PCS-C consists of 13 items describing different thoughts and feelings that children may experience when they were in pain. Children rate how frequently they experience each of the thoughts and feelings when they are in pain using a 5-point scale (0 = 'not at all', 4 = 'extremely'). The PCS-C yields a total score that can range from 0 to 52, and three subscale scores for rumination, magnification and helplessness. The PCS-C has shown to be a reliable and valid instrument in children from 9 to 15 years (Crombez et al., 2003).

Pain intensity and *anxiety* were assessed using an 11-point scale with the endpoints 'no pain' (0) and 'a lot of pain' (10), respectively 'not anxious/nervous' (0) and 'very anxious/nervous' (10). Children were prompted to provide written ratings of their pain ('how much pain did you have during this pressure?') and anxiety (how anxious and/or nervous were you during this pressure?') after each pressure.

Pain expression

A video camera recorded children's facial activity. The Child Facial Coding System (CFCS) (Breau et al., 2001; Chambers, McGrath, Gilbert, & Craig, 1996; Gilbert et al., 1999), which is derived from the Facial Action Coding System (Ekman & Friezen, 1978) was used to code children's pain expressions. The CFCS includes 13 facial actions (Brow lowering, squint, eye squeeze, nose wrinkle, nasolabial furrow, cheek raiser, upper lip raise, lip corner pull, vertical mouth stretch, horizontal mouth stretch, blink, flared nostril and open lips) and has been used in studies of acute procedural pain (Breau et al., 2001), postoperative pain (Gilbert et al., 1999), and experimentally induced pain (Chambers, Craig, Bennett, 2007). The CFCS has shown good reliability and validity in coding children's facial pain expressions (Gilbert et al., 1999). Facial actions were coded by two trained raters who were blind to the children's pain, anxiety and catastrophizing' ratings, and blind to the experimental condition. Ten facial actions were coded for intensity (no action (0), slight action (1), distinct/maximal action (2)), and three facial actions (blink, flared nostril, open lips) were coded as absent or present (0 or 1). Facial actions were coded for two time segments per pressure; the time during pressure (which varied slightly across children) and 5 seconds immediately after pressure ended. Coding of facial actions of the

latter segment was based upon pilot testing that indicated a significant amount of pain and facial pain expression immediately after the pressure ended. Interrater agreement was computed by having the second rater score 20% of the video segments of the first coder. For the coding of the facial actions, a user-friendly software program was developed by an IT specialist (ADC). By means of this software packet, videotapes could be programmed into fixed time segments (i.e. time segment during pressure and time segment 5 seconds immediately after pressure) which could each be viewed and re-viewed per second at a normal rate and at a rate of 1/10 of a second[2]. Reliability was calculated according to the formula given by Ekman and Friesen (1978) which assesses the proportion of agreement on actions recorded by two coders relative to the total number of actions coded as occurring by each coder. Reliability analysis indicated acceptable reliability (ranging from .62 to .93) for all facial actions, except for 'brow lower', 'flared nostril' and 'vertical mouth stretch'. Further analyses indicated that these 3 facial actions occurred with very low frequency across participants (less than 5%), indicating no substantial contribution to the total CFCS score. Consistent with approaches used in other studies, these 3 facial actions were excluded from further analyses (see e.g., Hadjistavropoulos & Craig, 1997; Hadjistavropoulos, Lachapelle, Hadjistavropoulos, Green, & Asmundson, 2002). Interrater reliability for overall frequency and intensity of the 10 remaining facial actions was found to be .77 and .72, respectively, indicating acceptable levels of reliability in CFCS coding (Breau et al., 2001; Gilbert et al., 1999). To control for the varying time length of the pressure children received, a mean score per second for each of the 10 facial actions was calculated for each segment. Because 8 of the 10 facial actions were coded on frequency and intensity (0, 1, or 2) and 2 were coded on frequency alone (0 or 1), the maximum facial action score per segment was 18. These were summed together to yield a total CFCS ranging between 0 and 36 for each pressure.

Procedure

Introduction phase

All participants were invited by telephone. Families showing interest in participating were asked whether the child could be accompanied by the principal caregiver of the family. This person was described as the person who spent most time with the child and who took care of most of the household chores. 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, two experimenters accompanied the parent and child to the test-room. Participants were explained that we were interested in "how children and parents think and feel about the pain that children experience". We described the pain procedure, and showed

[2] This software program is available on request by the first author.

the algometer. They were reminded of the possibility of their withdrawing participation at any time, and written parental consent and child assent were obtained.

The Parent and Stranger condition

Children were assigned to one of two conditions using a weighted random sampling procedure: i.e. random assignment with an equal proportion of boys and girls and with an equal age distribution in each condition: (1) a parent condition, in which the parent observed the child (n = 53 children, 43 mothers and 10 fathers) and (2) a stranger condition, in which a stranger (the second experimenter) observed the child. (n = 31 children, 28 mothers and 3 fathers).

Children and parents assigned to the parent condition were told that "…we also want to investigate how parents think and feel about the pain of their child", and that the parent was requested to answer some questions after each pressure. The second experimenter then accompanied the parent to an adjacent observation room in which the parent could observe the child.

Children and parents assigned to the stranger condition were told that "…the second experimenter is a student who was interested to learn more about the technical details of the pain procedure, and that the student needed to answer some questions after each pressure". The parent was asked to wait in a waiting room.

In both the parent and stranger condition, the child could not see the parent/stranger during the pressure tests. In the test-room a video camera was positioned in front of the child to record the child's pain behaviour during the pain procedure. The camera was connected with a television screen in the observer-room where either the parent or the stranger (second experimenter) was able to observe the child. (see Figure 1). The child was reminded of their presence after each pressure: after answering the questions the parent/stranger signalled that they were ready for the next trial using a two-way radio.

The Pain Threshold Test

Pain thresholds for the neck and the shoulder were established. For each tender point (i.e. neck and shoulder), pressure was induced by a single ascending trial to establish the pain threshold. The order of pressure location was counterbalanced across participants. Children were instructed to indicate when they started to feel pain by saying 'stop'. To ensure that children did not confuse pain threshold with pain tolerance, it was stressed that a pain threshold does not mean 'not being able to stand it anymore'. For each threshold, the child reported on their experience using the pain and anxiety scales.

The Experiment Phase

A total of 6 pressures (2 above, 2 equal to and 2 below the pain thresholds) were administered in a randomized order, each time followed by pain and anxiety ratings by the child. In order to minimize uncontrolled audience effects, during the test, the experimenter stood behind the child, did not have eye contact with the child, and did not talk to the child about

issues other than what was prescribed in the research protocol. When the experiment phase was finished, the child and the parent were debriefed and additional parental consent and child assent was obtained for the use of the facial video data.

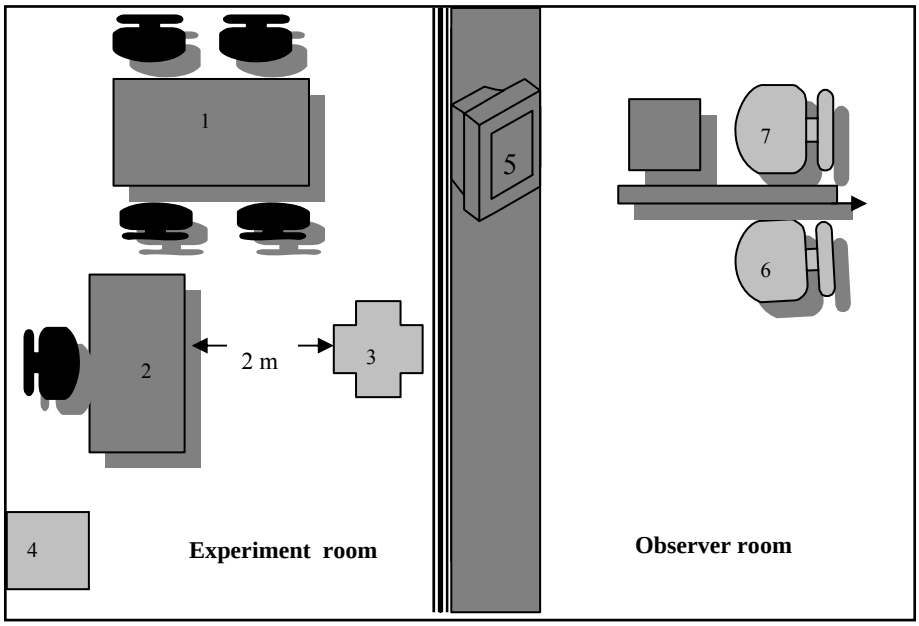

Figure 1: *Schematic representation of the experimental setting with the experimenter room and the observer room containing (1) place for instructions/debriefing, (2) place where child was seated, (3) camera position, (4) experimenter 1, (5) TV screen, (6) place where experimenter, and (7) parent/stranger were seated.*

RESULTS

Data reduction

Because we were not interested in the effects of body location (neck or shoulder), averages across neck and shoulder were calculated. This approach was justified because (1) corresponding variables for neck and shoulder were all significantly intercorrelated (range .26-.84), and (2) because analyses of the effects of parental presence and catastrophizing upon neck variables and shoulder variables indicated similar results. As a result, for the Pain Threshold Test, there was one pain expression score, one anxiety rating, one pain rating, and one pain threshold. For the Experiment Phase, there were three pain expression scores, three anxiety ratings and three pain ratings.: one pain expression/anxiety/pain score during pressure above the pain threshold (+70kg/cm^2), one during pressure at the pain threshold, and one during pressure below the pain threshold (-70kg/cm^2).

Descriptive statistics

Mean scores, standard deviations and correlations between measures are reported in Table 1. The mean level of catastrophic thinking about pain was similar to those in a large school sample of children (Crombez et al., 2003). Scores on pain catastrophizing ranged from 1 to 39 and were normally distributed (Kolmogorov-Smirnoff *KS Z*-score = 1.16, ns). The mean pain threshold level, across neck and shoulder, was comparable to mean pain threshold levels in other samples of children without pain (Hogeweg, Kuis, Oostendorp, & Helders, 1995). Pain threshold scores ranged from 60.5 to 565.5 kg.cm^2 and were normally distributed (*KS Z*-score = .86, ns). Children reported moderate levels of pain and anxiety during the Pain Threshold Test. The experienced pain at the pain threshold during the Pain Threshold Test was similar to experienced pain at the pain threshold during the Experiment Phase ($t(83) = -1.08$, ns). However, anxiety at the pain threshold during the Pain Threshold Test was higher than anxiety at the pain threshold during the Experiment Phase ($t(83) = 7.10$, $p < .0001$). Also, facial pain expression at the pain threshold during the Pain Threshold Test was more pronounced than facial pain expression at the pain threshold during the Experiment Phase ($t(83) = 2.87$, $p < .01$).

Correlation analyses revealed that age was positively correlated with pain threshold ($r = .33$ $p < .005$), and negatively correlated with pain expression ($r = -.21$, $p = .05$) during the experiment phase. Age was also positively correlated with self-reported pain during the experiment phase ($r = .23$, $p < .05$). Furthermore, girls reported higher levels of pain intensity ($t(82) = -2.42$, $p < .05$) during the experiment phase in comparison with boys. There was no correlation between pain catastrophizing and the pain threshold. Correlations amongst pain expression, pain and anxiety ratings during the Pain Threshold Test and the Experiment Phase are also reported in Table 1. There were significant positive correlations between pain intensity and anxiety ratings during the Pain Threshold Test and during the Experiment Phase. No significant correlations were found between pain expression scores and pain and anxiety ratings.

Plan of statistical analyses

The primary outcome of this experiment is the facial pain expression. For the Pain Threshold Test, we used an analysis of variance (ANOVA) with parental presence (parent present versus stranger present) as a between group factor and pain catastrophizing as a covariate. For the Experiment Phase, we used a 2 (parental presence: parent present versus stranger present) x 3 (Pressure Intensity: pressure below pain threshold, pressure at pain threshold, pressure above pain threshold) ANOVA with pain catastrophizing as a covariate. Pressure Intensity was a within subject variable. To partial out the impact of demographic variables upon pain expression, we controlled for the child's age, gender and the interaction between age and gender in each analysis.

Table 1

Means (M), Standard Deviations (SD) and Pearson intercorrelations of measures during the Pain Threshold Test (PTT) and Experiment Phase (EP)

	M (SD)	2	3	4	5	6	7	8	9	10	11	12	13	14
1.Pain Catastrophizing	14.34 (8.37)	.13	.16	.21*	.27*	.25*	.16	.12	.14	.12	.13	.05	.04	.11
2. Pain Threshold	269.35 (10.45)	---	-.13	-.10	-.04	-.02	.32**	-.11	-.10	.05	.03	.11	.-02	.02
3. Pain intensity_PTT	4.36 (2.15)		---	.43**	.65***	.67***	.52***	.41***	.38***	.36***	-.04	-.11	-.06	-05
4. Anxiety_PTT	4.74 (4.32)			---	.39***	.47***	.53***	.76***	.81***	.79***	.16	.12	.03	.06
5. Pain intensity _EP_above Pain Threshold	5.41 (2.45)				---	.86***	.68***	.46***	.35**	.32**	-.10	-.04	-.19	-.04
6. Pain intensity _EP_equal Pain Threshold	4.58 (2.40)					---	.72***	.46***	.50***	.42***	-.08	-.17	-.15	-.19
7. Pain intensity_EP_below Pain Threshold	3.16 (2.18)						---	.48***	.49***	.61***	.04	-.03	-.01	.02
8. Anxiety_EP_above Pain Threshold	2.88 (2.44)							---	.85***	.83***	.09	.11	-.03	.03
9. Anxiety_EP_equal Pain Threshold	2.49 (2.12)								---	.88***	.09	.05	-.07	.02
10. Anxiety_EP_below Pain Threshold	2.01 (2.07)									---	.08	.09	.03	.11
11. Pain Expression_PTT	4.37 (2.93)										---	.44***	.51***	.44***
12. Pain Expression_EP_above PainThreshold	4.15 (3.80)											---	.76***	.58***
13. Pain Expression_EP_equal Pain Threshold	3.45 (3.00)												---	.71***
14.Pain Expression_EP_below Pain Threshold	2.70 (2.09)													---

* $p < .10$; ** $p < .05$; *** $p < .01$* $p < .10$; ** $p < .05$; *** $p < .01$

Moderation analyses followed the procedures outlined by Aiken and West (1991) and Holmbeck (2002); i.e. (1) all continues predictor variables were centered and (2) significant interactions were investigated by plotting and testing the significance of the regression lines for high (+1 *SD* above the mean) and low (-1 *SD* below the mean) values of the moderator variable (Aiken & West, 1991; Holmbeck, 2002).

There were also some secondary outcomes in this study, in particular the self-reported pain intensity and self-reported anxiety during the Pain Threshold Test and during the Experiment Phase. We ran similar analyses as described above for these variables. In all analyses, Greenhouse-Geisser corrections (with adjusted degrees of freedom) were performed and stated whenever the sphericity assumption was violated (Mauchly's Test of Sphericity; $p < .05$).

Facial pain expression

Pain Threshold Test

An ANOVA with parental presence (parent present versus stranger present) and pain catastrophizing as covariate upon the facial pain expression revealed no significant main effect for parental presence ($F(1,77) = .86$, ns); children expressed as much pain in presence of their parent than in presence of a stranger. The effect of catastrophizing was also not significant ($F(1,77) = 1.42$; ns). However, there was a significant interaction between pain catastrophizing and parental presence ($F(1,77) = 7.38$; $p < .01$), indicating that the effect of parental presence upon pain expression is conditional on levels of catastrophizing of the child. To illustrate the pattern reflected in this statistically significant interaction term, we plotted regression lines for high (+1 *SD* above the mean) and low (-1 *SD* below the mean) values of the moderator variable (see Aiken & West, 1991; Holmbeck, 2002). These regression lines are shown in Figure 2. Analyses revealed that Low catastrophizing children displayed more pain expression in the presence of their parent than in the presence of a stranger ($\beta = -.39$, $p < .01$). For high catastrophizers, pain expression did not vary as a function of parental presence ($\beta = .19$, ns); their level of pain expression was equally pronounced regardless of whether a stranger or their parent was observing them. Further analyses indicated that high catastrophizers' pain expression only differs from low catastrophizers' pain expression when a stranger is observing them ($\beta = .51$, $p < .01$): high catastrophizing children showed more pain expression. Level of catastrophizing has no effect upon pain expression when their parent is observing them ($\beta = -.17$, ns). In addition, there were no significant effects of the child's age ($F(1,77) = .02$, ns), gender ($F(1,77) = 1.01$, ns) and the interaction between age and gender ($F(1,77) = .69$, ns).

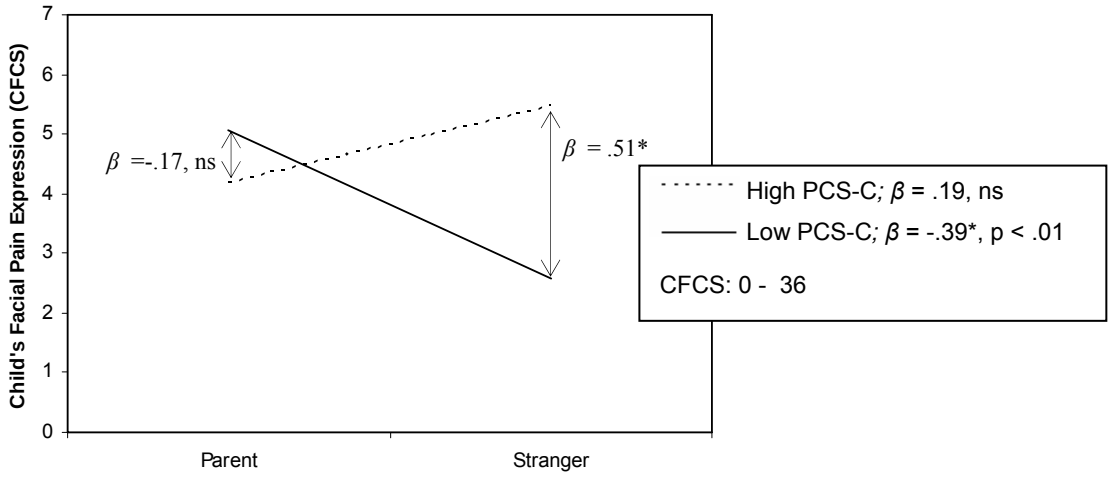

Figure 2: *Regression lines for the relationship between Parental presence and Facial pain expression of the child during the Pain Threshold Test as moderated by Catastrophizing of the child. Standardized Beta's (β) are shown (PCS-C = Pain Catastrophizing Scale for Children). Higher CFCS scores indicate higher level of pain expression.*

* $p < .01$

Experiment Phase

A 2 (Parental Presence: parent present versus stranger present) x 3 (Pressure Intensity: below pain threshold, at pain threshold, above pain threshold) ANOVA with pain catastrophizing as a covariate upon facial activity revealed a significant main effect of pressure intensity ($F(1,77) = 14.53$; $\epsilon = .83$; NDf(.83, 63.91); $p < .0001$). Pain expression of the child increased with higher levels of pressure. The effect of pain catastrophizing did not reach significance ($F(1,77) = 0.54$, ns). There was also no significant main effect of parental presence ($F(1,77) = 3.81$, ns). However, the two-way interaction of catastrophizing × parental presence reached significance ($F(1,77) = 4.11$; $p < .05$). The interaction effect of pain catastrophizing × parental presence × pressure intensity was not significant ($F(1,77) = 0.76$; $\epsilon = .83$; NDf(.83, 63.91); ns), indicating that the interaction of catastrophizing × parental presence was similar for the varying levels of pressure intensity. Results of the significant catastrophizing x parental presence interaction revealed similar, though less pronounced effects, as those obtained during the Pain Threshold Test. Significance tests for both slopes, however, indicated that the Low Catastrophizing (-1 *SD* below the mean) regression line failed to reach significance ($\beta = -.26$, ns). The slope for the High Catastrophizing regression line (+1 *SD* below the mean) was also not significant ($\beta = .17$, ns). Further analyses indicated that the effect of pain catastrophizing upon the expression of pain within each condition was, again, similar but less pronounced effects as those obtained during the Pain Threshold Test. High catastrophizers' pain expression tends to differ from low catastrophizers' pain expression when a stranger is observing them. However, this effect failed to reach significance ($\beta = .30$, ns). Level of catastrophizing has also no significant effect upon pain expression when their parent is observing them ($\beta = .14$, ns).

Of the demographic variables, only age had a significant contribution ($F(1,77) = 5.13$; $p < .05$), with older children expressing lower levels of pain. There was no significant effect for gender ($F(1,77) = .01$; ns), nor for the interaction gender × age ($F(1,77) = 2.91$; ns).

Secondary analyses

Similar analyses as described above were performed for self-reported pain intensity and anxiety during the Pain Threshold Test, respectively the Experiment Phase.

Pain Threshold Test

Pain ratings

The ANOVA with parental presence as a between group factor and pain catastrophizing as covariate upon self-reported pain intensity revealed no significant effects. Pain intensity did not vary as a function of pain catastrophizing ($F(1,77) = 1.29$, ns), parental presence ($F(1,77) = 0.12$, ns), or the interaction between parental presence and catastrophizing ($F(1,80) = 0.99$, ns). There were also no significant effects of the child's age, gender or the interaction between the child's age and gender (all $F(1,77) < .86$, ns).

Anxiety ratings

A similar analysis upon self-reported anxiety of the child revealed a significant main effect of catastrophizing ($F(1,77) = 4.24$; $p < .05$); the higher children's catastrophizing, the higher their anxiety. There were no other significant effects. Anxiety did not vary as a function of parental presence ($F(1,77) = .08$; ns) or the interaction between parental presence and catastrophizing ($F(1,77) = 2.94$; ns). In addition, there were also no significant effects of the child's age, gender or the interaction between the child's age and gender (all $F(1,77) < .98$, ns).

Experiment Phase

Pain ratings

A 2 (Parental Presence: parent present versus stranger present) x 3 (Pressure Intensity: below, at and above pain threshold) ANOVA with pain catastrophizing as a covariate upon pain intensity yielded a significant effect for pressure intensity ($F(1,77) = 74.15$; $\epsilon = .86$; NDf(.86, 66.22); $p < .0001$) indicating higher ratings of pain with higher levels of pressure. There was also a significant main effect for pain catastrophizing ($F(1,77) = 5.06$; $p < .05$). Higher levels of pain catastrophizing were related to higher pain intensity. The main effect of parental presence ($F(1,77) = .02$; ns), and the two-way interaction ($F(1,77) = .09$; ns), were not significant. Similarly, there was also no significant three-way interaction between level of pressure × parental presence × catastrophizing ($F(1,77) = 0.56$, ; $\epsilon = .86$; NDf(.86, 66.22); ns). Of the demographic variables, both age ($F(1,77) = 5.08$; $p < .05$) and gender ($F(1,77) = 4.19$; $p < .05$) had a significant contribution with girls and older children reporting more pain than boys and younger children. There was no significant interaction of child's age × gender ($F(1,77) = .16$, ns).

Anxiety ratings

The analysis on anxiety yielded a significant effect for pressure intensity ($F(1,77) = 22.15$; $\epsilon = .92$; NDf(.92,70.84); $p < .0001$) with higher anxiety ratings of the child when levels of pressure were higher. There were no significant effects of pain catastrophizing ($F(1,77) = 1.78$; ns), parental presence ($F(1,77) = .003$; ns) and the interaction between pain catastrophizing and parental presence ($F(1,77) = 2.41$; ns). There were no other significant interaction effects. In addition, there were also no significant effects of the child's age, gender or the interaction between the child's age and gender (all $F(1,77) < 1.63$, ns).

DISCUSSION

The present experiment investigated the impact of parental presence upon the *facial expression of pain* in children during pressure pain and examined the moderating role of the child's catastrophizing about pain. We expected (1) that children would express more pain in the presence of their parent compared to the presence of a stranger and that (2) this effect would be particularly pronounced for high catastrophizing children. The findings of the present study can be readily summarized. First, no main effect of parental presence was obtained: children expressed as much pain in presence of their parent than in presence of a stranger. Second, however, the child's level of catastrophizing significantly moderated the relationship between parental presence and facial pain expression. Again counter to our expectations, findings revealed that only children with a *low* frequency of catastrophic thoughts about pain expressed less pain in presence of a stranger than in the presence of their parent. For high catastrophizers facial pain expression was equally pronounced regardless of the relational status of the observer; it did not matter whether they were a parent or a stranger. Third, this pattern of results was most pronounced in the beginning of the study, i.e. during the Pain Threshold Test.

The findings of this study emphasize that characteristics of the social context, such as the presence of parents, and factors related to the intra-individual experience of pain, such as pain catastrophizing, interact in their effect on the expression of pain (Goubert et al., 2005; Hadjistavropoulos & Craig, 2002). Both an evolutionary explanation and an operant explanation may account for our finding that children expressed more pain in the presence of their parent than in presence of a stranger. From an evolutionary perspective, it is plausible that children *suppressed* the facial expression of pain in the presence of a stranger because the response of a stranger is uncertain: there is a possibility that a stranger will respond with help, but there is also the chance that the stranger will respond punitively. In these situations, the ability to suppress pain may be of particular advantage (Williams, 2002). In contrast, identification of a potential caregiver -the child's parent in this case- might give rise to a release of suppression (Kleck et al., 1976; Williams, 2002). From an operant perspective, the presence of solicitous others may be a discriminative stimulus for an amplified pain expression (Newton-John, 2002). These accounts are not incompatible. Evolutionary grounds may be at the roots of our findings, whereas a specific history of social contingencies to pain expression of the child (e.g., parental

attention to pain) may further shape and refine the impact of parental presence (Crombez et al., 2003). The above explanations may only apply for those children reporting low levels of catastrophic thinking about pain.

Findings indicated that only children who scored *low* on the measure of catastrophic thinking about pain had less facial expression in the presence of a stranger compared to the presence of their parent. The facial expression of the high catastrophizers did not vary as a function of parental presence. They showed equal levels of pain expression, regardless of whether the observer was a parent or a stranger. It is highly unlikely that this pattern of results can be explained by differences in pain intensity or anxiety because this pattern of results was not found for self-reported pain intensity, nor for self-reported anxiety. One possible explanation is that the high threat value of pain in children with catastrophic thoughts about pain overrules the ability to suppress the expression of pain. Such a phenomenon is similar to one described in the emotion literature and known as "emotional leakage" (Ekman & Friesen, 1969). As is the case for other aspects of the pain experience, it is conceivable that the expression of pain is dependent upon its affective-motivational characteristics, and not upon its sensory characteristics (Eccleston & Crombez, 1999; Price, 1999). Other findings can be viewed as support for this interpretation. Our results were most pronounced at the beginning of the experiment. Probably, children were more anxious because of unfamiliarity with the experimental procedure. The observation that facial activity in response to pain is most pronounced during the very first experiences with pain is in line with previous research on facial activity in response to heat pain (Crombez, Eelen, & Baeyens, 1997).

Pain that is experienced as threatening, may be conceived of as adaptive. It urges actions to escape from the physical threat. Pain is commonly associated with patterns of particular facial expressions that can be detected by significant others, who may then act to influence the state of the person in pain, perhaps most often with help or comfort. Children with a high frequency of catastrophic thoughts, however, seem to display an *indiscriminate* cry for help. There is a pronounced facial expression regardless of who is present, and regardless of whether they are experiencing high or low pain intensity. In the long term, such indiscriminate facial expression of pain may result in a greater diversity of social consequences, including positive (Giardino, Jensen, Turner, Ehde, & Cardenas, 2003) as well as negative responses (Boothby, Thorn, Overduin, & Ward, 2004; Keefe et al., 2003). This may, in turn, make the experience of high pain catastrophizers' more aversive, increasing its threat value (Buenaver, Edwards, & Haythornthwaite, 2007; McCracken, 2005; Newton-John, 2002). A further corollary of the frequent and indiscriminate communication of pain and pain related distress is that it may lead to a familiarity bias on the part of the observer, thereby increasing the chances of the failure to respond to a new or serious need for assistance or support: a "crying wolf" social phenomenon. What we may be observing in high pain catastrophizers is a failure of a pain communication suppression mechanism. Suppression of pain may have survival value in a social group in which the value of pain as a sign of serious threat for group members needs to be protected (Crombez & Eccleston, 2002).

Some limitations of the present investigation deserve consideration. First, this study used experimental pain in a controlled environment, and extrapolation to naturally occurring pain should be done only cautiously. Second, this study used an experimentally controlled design in a laboratory setting, in order to isolate the effects of specific variables. Therefore its ecological validity was low. The clinical validity of these findings remains an empirical question to be investigated. More specifically, in a sample of children who have clinically relevant pain occurring in a medical environment (e.g.,, pain due to acute medical procedures), will high pain catastrophizing children indiscriminately communicate pain via their facial expression? Third, in this study we did not include a no-observer control group. In any replication it would be helpful to know whether children facially express pain when instructed that no one is observing.

These findings suggest a number of avenues of further research. First we have argued that modulating the expression of pain dependent upon the relational identity of observer may have an adaptive function. This finding is preliminary and should be replicated. It will be necessary to investigate under what other conditions such an adaptive function can be extinguished, diminished or enhanced. We have not, for example, attempted to influence the expression of pain through instruction, or through particular characteristics of the parental observer. It is possible, for example, that the extent to which parents catastrophize about the pain of their child, or their own pain, may affect child pain displays. Second, to gain a full understanding of the social modulation of pain displays in high catastrophizing children, studies examining the moderating impact of diverse social contingency patterns are recommended. Third, we know nothing about the clinical case of chronic pain. It will be interesting to establish whether these effects occur in patients with chronic pain and their parents.

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GENERAL DISCUSSION

PREFACE

Catastrophic thinking about pain, characterized by an individual's tendency to focus on, exaggerate the threat value of painful stimuli and negatively evaluate one's own ability to deal with pain, has increasingly being recognized as one of the most salient determinants of adjustment to pain (Sullivan, Bishop, & Pivik, 1995; Sullivan et al., 2001). Catastrophizing may exert its negative impact upon pain outcomes through its associated effect upon the sufferer's *intra*-individual functioning. Specifically, catastrophic thinking may install a hypervigilance to pain thereby facilitating behaviours aimed at avoiding or escaping pain (Eccleston & Crombez, 2005). This may be beneficial in the short term, but become maladaptive when pain persists (Crombez et al., 2003). Most of the research on pain catastrophizing, however, concerns adult samples (see e.g., Keefe, Brown, Wallston, & Caldwell, 1989; Goubert, Crombez, & Van Damme, 2004; Sullivan et al., 1995). Relatively few studies have addressed catastrophic thinking in pediatric samples. Available findings, however, are in line with those of the adult literature (see e.g., Crombez et al., 2003; Hermann, Hohmeister, Zohsel, Ebinger, & Flor, 2007; Pirra, Taplin, Goodenough, & von Baeyer, 2002) and attest to the importance of assessing pain catastrophizing in children. To date, no study has addressed the distinctive role of catastrophizing in children and adolescents in relation to the effects of related constructs such as negative affectivity. In addition, all studies in children are cross-sectionally desgined, leaving us ignorant as to the antecedent or causal status of catastrophizing for pain outcomes.

In addition, catastrophizing may also exert its negative impact upon pain outcomes through its impact upon the *inter*personal or social environment. Sullivan et al. (2001) suggested catastrophizing is related to a communal or emotionally expressive orientation toward dealing with pain. Catastrophizer's heightened pain expression may function as social communication directed toward obtaining proximity and support (Keefe et al., 2000; Sullivan, Martell, Savard, & Crombez, 2006). Evidence for heightened associations between pain catastrophizing, pain expression and caregiver responses stems from studies with adults (see e.g., Keefe et al., 2003; Sullivan, Adams, & Sullivan, 2004). There is no systematic research on the social-behavioural dimensions of pain catastrophizing in children and adolescents.

This dissertation aimed to contribute to the scarce number of studies that is currently available on the role of pain catastrophizing in children and adolescents. A first objective of this dissertation is to investigate the role of catastrophizing and its putative differential predictive value in relation to negative affectivity in the explanation of pain outcome measures, such as heightened pain intensity and disability. Relationships were tested both cross-sectionally and prospectively. A second objective of this dissertation is to investigate the communicative dimensions of pain catastrophizing in children and adolescents. Specifically, a series of studies using different samples and different methodologies, were conducted in which the association

between the child's catastrophic thinking about pain and the extent to which they engaged in pain expression was examined.

We begin this general discussion with a summary of the main study findings. Next, theoretical implications of our results will be discussed in relation to some broader considerations regarding the current view on catastrophizing and pain expression. Throughout this discussion, we will also indicate clinical implications and highlight the limitations of our studies. Finally, a number of recommendations and guidelines for future research will be provided.

MAIN FINDINGS

PAIN CATASTROPHIZING AND PAIN OUTCOMES IN CHILDREN AND ADOLESCENTS

The research reported in Chapters 1 and 2 aimed at exploring the differential predictive value of pain catastrophizing and negative affectivity in the explanation of diverse pain outcome measures in children. **Chapter 1** reported two cross-sectional questionnaire studies, one in a sample of school children (n = 193), and a second one in a clinical sample of children and adolescents with chronic or recurrent pain (n = 43). In these studies, we investigated the value of catastrophic thinking about pain in explaining pain, disability, and somatic complaints, beyond the effect accounted for by negative affectivity. When conditions for mediation (Holmbeck, 2002) were met, we also tested whether pain catastrophizing mediated the relationship between negative affectivity and the three outcome measures. The results showed that the contribution of negative affectivity in explaining somatic complaints, pain intensity and disability was small or non-existent in both studies. The role of pain catastrophizing in explaining these three outcome measures was substantial, even when controlling for the effects of negative affectivity. Explained variance rates ranged from .11 to .38. In addition, pain catastrophizing strongly mediated the relationship between negative affectivity and somatic complaints in the sample of school children and the clinical sample of children, and between negative affectivity and disability in the sample of school children. The cross-sectional design of these studies, however, does not allow inferences about the antecedent status of catastrophizing for later pain outcomes. **Chapter 2** therefore proceeded on the results of chapter 1 as a prospective questionnaire study in a sample of school children (n = 323). In this study, we investigated the prospective roles of catastrophic thinking about pain and negative affectivity and their putative relationship with pain and disability six months later. We also investigated whether the relationship between catastrophizing and pain and disability at follow-up was moderated by the child's baseline pain intensity level. Results indicated the child's pain catastrophizing at baseline had a small but significant effect upon pain and disability six months later, even when controlling for the initial pain and disability levels. Moderation analyses, however, revealed that the effects of catastrophizing upon pain and disability at follow-up where particularly pronounced for those children who reported low levels of pain intensity at baseline.

Children who already reported high levels of pain at baseline also reported higher levels of pain and disability 6 months later, irrespective their level of catastrophizing at baseline. Similar to the findings reported in chapter 1, the findings of this prospective study further indicated that negative affectivity did not account for the effects of catastrophizing upon pain and disability six months later. Instead, negative affectivity might better be conceived of as a precursor of catastrophizing: i.e. children with higher levels of negative affectivity at baseline reported higher levels of pain catastrophizing at follow-up. Of further interest, the stability of catastrophizing over a 6-month period in this sample of school children was moderate (r = .42).

PAIN CATASTROPHIZING AND PAIN EXPRESSION IN CHILDREN AND ADOLESCENTS

Whereas chapter 1 and chapter 2 reported on the extent to which catastrophizing contributes to deleterious pain outcomes in children, the subsequent 4 chapters addressed the extent to which pain catastrophizing in children and adolescents contributes to heightened pain expression. In the studies presented in chapter 3 and chapter 4, associations between the child's level of catastrophizing and different types of pain expression were investigated. The studies presented in chapter 5 and chapter 6 provided a closer examination of the specifics of the relationship between the child's catastrophizing and their facial display of pain. The study presented in chapter 5 examined whether catastrophizing moderated the relationship between the child's self-report of pain and facial pain expression, respectively parental ratings of their child's pain. The study presented in chapter 6 examined whether catastrophizing moderated the relationship between parental presence and facial pain expression.

Pain catastrophizing and different types of pain expression

Pain behaviours encompass a broad range of actions including verbal behaviours, such as verbalizations about the pain to others, as well as a large variety of non-verbal behaviours including facial display of pain and other behaviours such as guarding, rubbing or holding the painful spot (Prkachin, 1986; Williams & Craig, 2006). Pain behaviours have been discussed in terms of their communication function and their pain management or protective function (Hadjistavropolous & Craig, 2002; Sullivan et al., 2006a; 2006c; Williams & Craig, 2006). Different behaviours may serve different functions. For example, pain behaviours, such as guarding or rubbing might primarily serve to protect the body from further harm or injury. Other behaviours, such as verbalizations about the pain and the facial expression of pain do not necessarily serve an immediate or physical protective function but might primarily serve to communicate pain to others. (Craig, 2004; Sullivan et al., 2006a; Williams, 2002). The studies reported in chapter 3 and chapter 4 aimed at investigating the relationship between the child's level of pain catastrophizing and different types of pain expression. **Chapter 3** reported on a cross-sectional questionnaire study in a sample of school children (n = 659) and their parents (n =632 mothers and 484 fathers) and a sample of children with chronic or recurrent pain (n = 61) and their parents (n = 52 mothers and 34 fathers). This study investigated the relationship

between the child's pain catastrophizing and (1) the child's tendency to verbally share their pain experience with others, and (2) different dimensions of pain expression, as described by the mother and the father, including verbal and non-verbal communicative pain behaviours and protective pain behaviour. In addition, differences between the two samples were examined and discussed. Findings indicated that higher levels of pain catastrophizing were associated with children's greater self-acknowledged tendency to verbally share their pain experience with others. Complementing with the previous finding, paternal and maternal perceptions of the verbal and non-verbal communicative pain behaviour of their children were uniquely and positively related to pain catastrophizing. In addition, but only for fathers, higher levels of pain catastrophizing were also uniquely associated with higher levels of protective pain behaviours. There were some marked differences between school children and the clinical sample. Children of the clinical sample experienced more severe pain, more pain catastrophizing, more protective pain behaviour, but fewer verbal communications about their pain. However, the role of catastrophizing in explaining expressive behaviour as reported by the child and as rated by both parents did not differ between the sample of school children and the sample of children with chronic or recurrent pain. The findings of this study further corroborated the findings of the adult literature that higher levels of catastrophizing are associated with a more expressive orientation in dealing with pain (see e.g., Keefe et al., 2003; Sullivan et al., 2004a; 2006a). Specifically, the consistent finding that the child's catastrophizing positively impacted upon (1) their tendency to verbally share their pain experience with others and upon (2) both parental accounts of communicative pain behaviours suggest pain catastrophizing contributes to heightened expression of communicative pain behaviours. Extending this perspective, the findings in **chapter 4** reported on an observational study in a sample of adolescents with chronic pain in which we investigated the association between catastrophizing and the extent to which the adolescents (n = 38) engaged in different types of pain expression whilst performing a painful task. Adolescents were observed on video while performing a 2 Minute Walk Test, which allowed coding of facial pain expressions and protective pain behaviours of the adolescent. Parents provided written ratings about the extent to which their child had been talking to them about the pain task. This index provided an index of the adolescents' verbalizations about the pain task. Findings indicated that higher levels of catastrophic thinking about pain were associated with higher levels of communicative pain behaviours, but not with protective pain behaviours. Specifically, higher levels of adolescents' catastrophizing were associated with both higher levels of facial pain expression and higher levels of verbalizations about their pain experience. Unlike communicative pain behaviours, protective pain behaviours did not vary with the adolescents' level of catastrophizing. Instead, protective pain behaviours varied more closely with characteristics of the pain, with higher levels of pain being associated with higher levels of protective, but not communicative pain behaviours. The findings reported in chapter 3 and chapter 4 emphasize the importance of recognizing that different dimensions or types of pain expression respond differently to variations in catastrophic thinking about pain. Specifically, both child-report measures, parent-report measures and behavioural measures, in

clinical and non-clinical samples, indicated higher levels of catastrophic thinking about pain were consistently related with higher levels of communicative pain behaviours.

The moderating role of pain catastrophizing in understanding the facial expression of pain

The findings reported in chapter 3 and chapter 4 indicated that the child's level of pain catastrophizing contributes to heightened levels of pain expression. Specifically, analyses showed this is particularly true for the display of communicative pain behaviours; i.e. verbalizations about the pain and facial expression of pain. There is, however, a multitude of factors that might influence the extent to which a sufferer's pain becomes manifest socially (Hadjistavropolous & Craig, 2002). Both characteristics of the pain and characteristics of the social context may be important in this regard. In chapter 5 and chapter 6, we argued that pain catastrophizing might be important in moderating the effects of both self-reported-pain (chapter 5) and parental presence (chapter 6) upon the facial display of pain. Specifically, catastrophizing might impact upon the extent to which facial pain display provides a clear signal to self-reported pain states (Labus, Keefe, & Jensen, 2003). In chapter 5, we hypothesized that self-reports of pain would be positively associated with facial expression of pain, but only in case the child reported low levels of catastrophizing. For high catastrophizing children, we expected even low levels of pain to be sufficient to give rise to heightened facial expression of pain. Catastrophizing may also impact upon the extent to which presence of others influences a child's facial pain expression. In chapter 6, we hypothesized that children would show more facial pain expression in presence of a parent than in presence of a stranger (Williams, 2002). To the extent that parents have been the targets of previous pain displays and are therefore likely to have played a role in the maintenance of catastrophizing (Sulivan et al., 2001), we expected this effect to be particularly pronounced for high catastrophizing children.

The findings presented in **chapter 5** reported on an observational study in a sample of school children (n = 62) and their parents (50 mothers, 12 fathers). The children were observed by their parent whilst children experienced pain by means of a cold water procedure. This study investigated the moderating role of the child's pain catastrophizing for the association between the child's self-report of pain and their facial expression of pain. In addition, we explored whether the impact of pain catastrophizing and the child's reported pain upon the child's facial display of pain was reflected in parental inferences of their child's pain. Findings showed that higher levels of child-reported pain were associated with higher levels of facial pain expression. This was, however, only true for those children who reported low levels of pain catastrophizing. High catastrophizer's facial pain display did not vary with the intensity of pain the children reported; they *indiscriminately* displayed their pain and showed as much pain whether their self-reported pain was high or low. A similar pattern was obtained for parental inferences of their child's pain; child pain report was positively associated with parental pain inferences, but only for children who reported low levels of catastrophizing. Counter to expectations, high catastrophizing children did not express more pain in general compared to low catastrophizing

children. On the contrary, for *high* intensity pain, facial pain displays of high catastrophizing children were even lower compared to children who were low on the measure of catastrophizing. This pattern, however, was in contrast with the pattern of parental pain inferences; for *low* intensity pain, parents of high catastrophizing children judged the pain of their child higher compared to low catastrophizing children. As such, it appeared that study hypotheses were more reflected in the pattern of parental pain inferences, and less so in the pattern of facial pain display of the child.

A final study, reported in **chapter 6**, investigated the moderating role of pain catastrophizing for the relationship between parental presence and the child's facial expression of pain. School children (n = 84) experienced varying levels of pressure pain (above, equal to and below their pain threshold) in either one of two conditions. In one condition, children were observed by their parent (n = 53). In the other condition, the children were observed by a stranger (n = 31). Findings of this study indicated no main effect for parental presence. There was, however, a significant moderation effect of the child's pain catastrophizing indicating children showed more facial pain expression in presence of their parent than in presence of a stranger, but only in case the child reported infrequent or low levels of catastrophic thoughts about pain. For high catastrophizing children, an *indiscriminate* pattern of facial pain display was found. High catastrophizers' facial pain expression was equally pronounced regardless the relational status of the observer; they expressed as much pain in presence of their parent than in presence of a stranger. Although there was, again, no main effect of the child's catastrophizing upon the facial expression of pain, findings indicated high catastrophizer's expressed more pain in presence of a stranger compared to low catastrophizing children. Facial pain expression of low and high catastrophizing children did not differ in presence of their parent. It is unlikely that this pattern of results could be explained by differences in pain intensity or anxiety because this pattern of results was not found for self-reported pain intensity, nor for the child's self-reported anxiety. Contrary to findings reported in chapter 5, there was no interaction effect between the level of pressure pain and the child's pain catastrophizing upon their facial display of pain: i.e. both high and low catastrophizing children showed increasing levels of facial pain expression with increasing levels of pressure pain.

THEORETICAL IMPLICATIONS

THE DIFFERENTIAL IMPORTANCE OF PAIN CATASTROPHIZING AND NEGATIVE AFFECTIVITY IN CHILDREN AND ADOLESCENTS

It has been argued that a focus on specific patterns of anxious thinking, such as pain catastrophizing, may underestimate the role of stable individual differences (Ashgari, & Nicholas, 1999; Watson & Pennebaker, 1989). *Negative affectivity*, defined as a stable pattern of automatic negative emotional appraisal (Costa & McCrae, 1992; Watson & Clark, 1984) may be particularly salient in this context. According to Watson and Pennebaker (1989), persons

scoring high on negative affectivity are more likely to notice and attend to internal physical sensations and minor aches because their attentional scanning of both the external and internal environment is fraught with anxiety and uncertainty. Findings, both in adult as well as in child samples, indicating heightened positive associations between negative affectivity and pain catastrophizing (Brown, O'Keeffe, Sanders, & Baker, 1986; Sullivan et al., 1995) and negative affectivity and a range of health outcome measures (Bendebba, Torgerson, & Long, 1997; Harkins, Price, & Braith, 1989; Merlijn et al., 2003; Ondersma, Lumley, Corlis, & Tojek, 1997; Walker, Garber, Smith, Van Slyke, & Claar, 2001) has raised questions about the utility and distinctiveness of catastrophizing in accounting for deleterious outcomes (Sullivan et al., 2001; Turner & Aaron, 2001). The extent to which pain catastrophizing is one particular instantiation of negative affectivity has been addressed in several studies in adult populations. These studies indicated that the effects of catastrophizing cannot be accounted for by the more general effects of negative affectivity (Crombez, Eccleston, Van den Broeck, Van Houdenhove, & Goubert, 2002c; Goubert et al., 2004; Martin et al., 1996; Sullivan, Thorn, Rodgers, & Ward, 2004b). Rather, pain catastrophizing is an important underlying mechanism in accounting for the heightened associations between negative affectivity and pain outcomes (Affleck, Tennen, Urrowns, & Higgins, 1992; Goubert et al., 2004). In addition, findings in adults also suggested that negative affectivity might best be conceived of as a precursor or vulnerability factor for the development and maintenance of catastrophizing (Goubert et al., 2004). The findings presented in chapter 1 and chapter 2 extended this perspective and further disentangled the effects of catastrophic thinking and negative affectivity in children in accounting for children's pain outcomes. Despite significant associations between the child's catastrophizing and negative affectivity, we have shown, both cross-sectionally in a sample of school children and children with chronic pain (chapter 1) and prospectively in a sample of school children (chapter 2), that the variability in disability and pain complaint cannot be explained by the child's negative affectivity but is a function of more specific cognitive-affective factors such as the child's level of pain catastrophizing. Negative affectivity in children, however, was shown to be important in that it may predispose children to catastrophizing. Negative affectivity might therefore also be conceived of as a vulnerability factor for pain catastrophizing in children (chapter 2).

THE CONCEPTUALIZATION OF EXPRESSIVE DIMENSIONS OF PAIN CATASTROPHIZING

This dissertation (part II) extended and further corroborated on findings of the adult literature indicating that higher levels of catastrophizing are associated with a more expressive orientation in dealing with pain (Keefe et al., 2003; Sullivan et al., 2004a; 2006a). Specifically, the investigation of the association between catastrophic thinking about pain in children and the extent to which they engage in pain expression revealed two important findings. First, child's catastrophizing did not have a similar impact upon different types of pain expression; i.e. catastrophizing was most consistently related with *communicative* pain behaviours (chapter 3 and chapter 4), but not (chapter 4) or less so (chapter 3) with protective pain behaviours. This

finding was consistent across different samples (clinical and non-clinical samples) and varying methodologies (self-report, parent-report and observational measures). Second, high catastrophizer's pain display seems to reflect an *indiscriminate display of pain*: i.e. high catastrophizing school children express as much pain regardless the reported intensity of their pain (chapter 5) and regardless the audience present (chapter 6). Why catastrophizer's pain display reflects either a heightened engagement in communicative pain behaviours or an indiscriminate display of pain can be viewed in light of theorizing on pain catastrophizing in the context of seeking help.

Pain catastrophizing: a cry for help?

Sullivan et al. (2001) suggested that catastrophizing is related *primarily* to a communal and emotionally expressive orientation toward dealing with pain and distress situations and that interpersonal or caregiving goals are *primary* in high catastrophizers. In fact, for high catastrophizing persons, who feel helpless and threatened about their pain, obtaining other's sympathy, help and care may be more important than that it actually reduces their pain. Through heightened display of their pain and communicating an inability to deal effectively with a painful situation, high catastrophizing children may be maximizing the probability that others will maintain proximity or offer support or assistance (Sullivan, Tripp, & Santor, 2000; Sullivan et al., 2001). As such, catastrophizing may reflect an adaptive orientation in dealing with pain. *Communicative* pain behaviours such as verbalizations about the pain, and especially, the facial expression of pain have been found to be highly important in eliciting the perception of pain in others (Hadjistavropolous, Craig, Grunau, & Withfield, 1997; Kappesser, Williams, & Prkachin, 2006; Poole & Craig, 1992) and hence, may be the primary source of communicating a need for help. Instead, the role of protective pain behaviours as a cue for others to infer pain appears largely to be secondary (Hadjistavropolous et al., 1997; Sullivan et al., 2006a). They differ from communicative pain behaviours in that they more immediately control or minimize the pain (Craig, 2004; Sullivan et al., 2006a; 2006c; Williams & Craig, 2006).

Our findings indicating the child's catastrophizing is most consistently related with communicative pain behaviours and less so or not with protective pain behaviours (chapter 3 and chapter 4) further corroborates the idea that catastrophizing serves primarily a social communicative function aimed toward maximizing the probability that their pain will be managed within an interpersonal context (Sullivan et al., 2001). Specifically, high catastrophizing children may not only express they feel threatenend and helpless by the pain, they might also be perceived as such by others, and perhaps particularly so because they take minimum or no action (Sullivan et al., 2004a) or possibly wait longer (Bédard et al., 1997) to *directly* control or reduce their pain. Here, several possible explanations might be advanced. First, for high catastrophizing individuals, engaging in protective pain behaviours may be at odds with their primary need of dealing with pain and distress within an interpersonal context. Second, it is also plausible that high catastrophizer's do not engage in protective pain

behaviours because they are less efficient in directly controlling or minimizing their pain. Previous findings indicating catastrophizers' report using a similar number of coping strategies as non catastrophizers, and are thus equally equipped to deal with painful situations, they differ in that only for non catastrophizers number of coping strategies contributes to pain reduction (Heyneman, Fremouw, Gano, Kirkland, & Heiden, 1990; Sullivan et al., 1995). Third, pain reduction might just not be the most salient issue for individuals who highly catastrophize about pain. In chapter 4, we argued, based upon the role of catastrophizing within the fear-avoidance model of pain, that protective pain behaviours may well comprise distinct groups of pain behaviours including those that are directly aimed at reducing pain and those that occur in fearful *anticipation* of pain (Vlaeyen & Linton, 2000). Inconsistencies in findings with some studies reporting heightened associations between catastrophizing and protective pain behaviours (chapter 3- father report; Sullivan et al., 2006a) and other studies failing to report such an association (chapter 4; Sullivan et al., 2004a) may possibly be explained by differences in the operationalisation and measurement of protective pain behaviours. Heightened pain expression in high catastrophizing individuals may, for example, vary more closely with behaviours aimed at escaping from or avoiding perceived threat, rather than with behaviours directly targeting the pain (Tang et al., 2007). Extending this perspective, catastrophizing and related behaviour may be more an expression or cry for help about what *might* be, than about what actually is or was (Eccleston & Crombez, 2007)[1].

Pain catastrophizing: an indiscriminate cry for help

Pain demands attention (Eccleston & Crombez, 1999). In particular high intensity pain might be least likely to go unnoticed, become salient and threatening for everyone, and hence, give rise to heightened engagement in pain expression that may, in turn, function as social communications aimed at obtaining other's help and care (Prkachin & Craig, 1995). Communicative pain behaviours, in particular facial expressions of pain are very powerful in this regard (Hajistavropolous et al., 1997; Poole & Craig, 1992). The picture, however, is less straightforward as one would expect; high facial expression of pain does not always reflect high self-reported pain (see also chapter 4; Labus et al., 2003). Dimensions other than the sensory characteristics of pain such as its experienced intensity, may be more important in understanding the extent to which individuals engage in facial displays of pain (Hadjistavropolous & Craig, 2002). For high catastrophizers, the warning function of pain may be much more located in the cognitive- affective experience of threat and fear than in its sensory quality (see chapter 3 and chapter 4). The effects of the child's catastrophizing upon their facial display of pain may, however, be less pronounced when pain is of high intensity and salient for

[1] This latter explanation may in fact also explain why effects of catastrophizing become most pronounced at lower levels of pain (chapter 2 and chapter 5- parent report).

everyone, but become most pronounced when even low levels of pain are perceived as threatening (Eccleston & Crombez, 1999). Accordingly, high catastrophizing individuals may, even at low levels of pain-report, demand other's attention by heightened display of their pain, in turn, instigating higher perceptions of pain in others (see chapter 5). Recent findings in adult students (Sullivan et al., 2006b) indicating that higher levels of catastrophizing are associated with higher pain inferences by others, *but* with a tendency of less as opposed to more congruency of inferred pain ratings, are also in support of this view. Specifically, these findings may suggest that although high catastrophizing individuals might express more pain, they might do this in an indiscriminate manner: i.e. expressing as much pain regardless its intensity. Similarly, we demonstrated (see chapter 5) that high catastrophizing children indiscriminately display pain, are perceived as such by their parent, but counter to expectations and findings reported in chapter 3 and 4, they did *not* engage in higher levels of facial pain expression.

Specificities of the social context, such as the presence of others may also be critical in understanding heightened levels of pain expression (Hadjistavropolous & Craig, 2002; Williams, 2002.). Studies have indicated that children, from an early age on, are able to modulate their expression of pain and distress (Buss & Kiel, 2004), and that they do so for a variety of reasons. Children's pain expression may vary, in part by the way a child is socialized to think about pain and behave when in pain (Craig, Stanford, Fairbairn, & Chambers, 2006; Fearon, McGrath, & Achat, 1996; Hatchette, 2005; Zeman & Garber, 1996), learning that may be influenced by a broader set of cultural display rules (Gnepp & Hess, 1986). Children are also aware of the interpersonal ramifications of expressing their pain and base their decisions to express, hide or even dissemble their pain on the type of response they expect to receive following a pain disclosure. For example, children as young as 9 years old report being less likely to express pain in front of a peer than in presence of their parent because they perceive peers to be less accepting of pain displays and responding more negatively than parents (Zeman & Garber, 1996). Children may also hide their pain because of other-protective reasons (Crombez & Eccleston, 2002a) like not wanting to worry or upset their parents (Larochette, Chambers, & Craig, 2006).

The expression of pain can have important effects on the establishment and preservation of social relationships, just as the social context can play an important role in further shaping an individual's decision to express or regulate emotional experiences. Operant principles have often been invoked to understand the modulation of pain expression. For the operant model, heightened levels of pain behaviour, defined in terms of magnification or exaggeration, can be understood from knowledge of an individual's reinforcement history (Fordyce, 1976). Not all pain behaviour, however, is shaped by external contingencies. The facial display of pain, for example, is innate and universal to all human beings (Prkachin, 1992), and probably evolutionary predetermined. Its adaptive value and evolutionary origins probably arose as a consequence of their capacity to grasp the attention of others, to engage others help and care and to warn others about possible danger. In turn, the ability to *suppress* pain expression would be of equal survival advantage to the sufferer in pain when in presence of antagonists. From an

evolutionary point of view, magnification of pain expression on the basis of previous reinforcement may therefore equally plausibly constitute a release of suppression when in presence of someone identified as a potential caregiver (Williams, 2002).

Both accounts, however, are not incompatible; a specific history of social contingencies to pain expression (e.g., solicitous responses; Block, Kremer, & Gaylor, 1980) may further shape and refine the impact of the presence of others who were already identified as potential caregivers. In fact, in as much as caregivers have been the targets of previous pain displays it is likely they may have played a role in the maintenance of pain expression (Sulivan et al., 2001). Following heightened associations between catastrophizing and communicative pain behaviours (chapter 3 and 4; and see also Sullivan et al., 2004a; 2006a), one might expect that catastrophizers' pain expression will be most pronounced in the presence of those from whom support and assistance have been experienced on previous occasions.

We demonstrated (chapter 6), however, that highly catastrophizing children *indiscriminately* displayed their pain. Specifically, high catastrophizing children expressed as much pain regardless the audience present and, when in presence of a stranger, they even expressed more pain compared to low catastrophizing children. Low catastrophizing children, on the other hand, expressed less pain in presence of a stranger compared to presence of their parent. To some extent, these findings are comparable with those of Sullivan et al. (2004a) who reported that high catastrophizing adults, but not low catastrophizers, expressed more facial pain in presence of a neutral observer (i.e. defined as a stranger in our study) than when alone. High catastrophizers may have difficulty suppressing pain expression and identify others, even those from whom help or care is uncertain, more easily as potential deliverers of care. Counter to expectations, we failed, again, to obtain a main effect of the child's catastrophizing upon their facial display of pain when in presence of their parent (see also chapter 5). This raises questions about the specific nature of parental responses to heightened pain display in their child and its potential impact upon the child's future pain experience, pain catastrophizing and related expression.

PAIN CATASTROPHIZING: AN ADAPTIVE ORIENTATION?

Pain, as an archetypal sign of threat, serves adaptive functions. First, pain demands the attention of the sufferer in pain, it interrupts ongoing activities and urges for avoidance or escape from the physical threat (Eccleston & Crombez, 1999; Williams, 2002). Second, by impelling expressive behaviours, pain does also attract the attention of others in the social environment, who might react with help and care (Craig, 2004; Goubert et al., 2005). As catastrophizing is an instantiation of the high threat value of pain (Sullivan et al., 1995), it follows that those who amplify the threat value of pain may enhance both processes (Crombez et al., 2003; Eccleston & Crombez, 1999). Catastrophizing may foster attentional interruption by pain, which, in turn, strongly relates to an active readiness to escape from or avoid a threat to the integrity of the body (Crombez et al., 2002c). Findings indicating avoidant strategies might

be associated with more positive adaptation in the short run (Suls & Fletcher, 1985) suggest this might indeed be considered as a normal and adaptive process, by protecting the individual from further bodily harm in case of acute painful situations[2]. In addition, more quickly noticing or attending to pain may also prevent heightened future interruption of pain in ongoing and valued roles and hence, reduce its impact.

In most individuals the pain of acute injury subsides quickly and healing occurs within hours, days or weeks. For some, however, pain persists and might still be interpreted as a signal of bodily threat. In fact, persons may become overly fearful when pain continues beyond the expected healing time or when pain increases while the person expected it to decrease. (Boersma & Linton, 2005). For those who suffer chronic pain, implying limited possibilities of escape, this signal function, however, is no longer adaptive since other environmental demands and activities are continuously interrupted by the pain (Crombez et al., 2002c; Crombez, Van Damme, & Eccleston, 2005; Eccleston & Crombez, 1999; Eccleston & Crombez, 2007; Vlaeyen & Linton, 2000). Heigthened catastrophizing (and perhaps especially so when initial pain is low; chapter 2), related hypervigilance to pain and escape/avoidance behaviours can become particularly dysfunctional in the long term. (Crombez et al., 2002c; Eccleston & Crombez, 2007; Boersma & Linton, 2005). Specifically, escape and avoidance behaviours diminish engagement in valued and daily activities, thereby fostering disability, disuse, depressed mood and pain. In addition, since avoidance behaviours occur in anticipation of pain rather than in response to it, these behaviours – no longer linked to actual pain experience- may persist because there are fewer opportunities to correct the erroneous expectancies about pain as a sign of danger (Vlaeyen & Linton, 2000).

Pain catastrophizing might also affect pain experience through its effects upon the social environment. Specifically, through heightened display of their pain, high catastrophizing children might be more demanding of social support and caretaking and be more dependent upon the care available through others (see e.g., chapter 3, 4, 6). Support and care from others, in turn, may have distress-, pain- or fear reducing properties and hence, serve protective social functions (Craig, 2004; Giardino, Jensen, Turner, Ehde, & Cardenas, 2003; Prkachin & Craig, 1995). This may be particularly adaptive in case of acute pain or emergency situations. Heightened pain displays increase the chance of receiving help from others, even help from those unknown to the person in pain. In fact, low catastrophizers might be at risk for not receiving the help they need, when they hide even high levels of pain in presence of strangers (chapter 6). In addition, high catastrophizers may more easily notice their pain and demand other's attention before the pain problem worsens and has become more difficult to alter (chapter 5 and 6).

[2] The absence of significant relationships between the child's catastrophizing and pain intensity in some of the observational studies (see e.g., chapter 4 and chapter 6) could possibly be accounted for by these mediating mechanisms that might come into play.

A persistent engagement in catastrophic thinking about pain, however, may, over time, also generate maladaptive effects (Sullivan et al., 2001, 2004a). First, others' responses may affect catastrophizing and associated pain outcomes, by positively reinforcing catastrophizing and related behaviour (Giardino et al., 2003; Guite, Rose, McCue, Sherry, & Sherker, 2007; Jolliffe & Nicholas, 2004; Linton, McCracken, & Vlaeyen, 2008; Sullivan et al., 2001). Second, increasing exposure to heightened pain expression (chapter 3 and 4) and/or being repeatedly falsely alarmed (chapter 5), may contribute to reduced sensitivity, a familiarity bias, or more conservatism in judging the sufferer's (child's) pain (Prkachin, Mass, & Mercer, 2004; Prkachin, Solomon, Hwang, & Mercer, 2001; Solomon, 2001). This may ultimately lead to failure of caregivers, such as parents, to respond with help when their child is in serious need. Third, as catastrophizers express as much pain regardless the audience present, it then follows that high catastrophizing may result in a greater diversity of social consequences, including getting appropriate help or care, but also receiving negative responses or getting no support or help at all (Williams, 2002). This may make catastrophizer's pain experience more ambivalent, more adverse, and, by intermittant reinforcement even more difficult to extinguish (Boothby, Thorn, Overduin, & Ward, 2004). Fourth, increased exposure to pain expression may also become aversive to others. In fact, viewing others in pain and empathizing with pain of the other may affect observers (caregivers) by eliciting distress (Goubert et al., 2005; Goubert, Vervoort, Sullivan, Verhoeven, & Crombez, in press; Keefe et al., 2003; Loggia, Mogil & Bushnell, in press). This may become particularly true for persons who are part of the social network of high catastrophizers (e.g., parents, spouses and other family members) in that they are likely to have repeatedly been the targets of previous displays. Findings indicating catastrophizing appears to evoke not just sympathetic and supportive responses, but, in particular over time (Cano, 2004; Buenaver, Edwards, & Haythornthwaite, 2007), also critical and punishing responses (see e.g., Boothby et al., 2003; Keefe et al., 2003) might be interpreted in this light. These latter type of responses may again further add to the aversiveness of pain experience and increase catastrophizer's vulnerability in dealing with pain (Buenaver et al., 2007; McCracken, 2005). Although the association between children's catastrophizing thoughts, catastrophizing behaviour and other's responses remains to be investigated, it might be that the specific history of parental responses to heightened display of pain in their child may have accounted for the failure to obtain a main effect of the child's pain catastrophizing upon their facial display of pain when in presence of their parent (see chapter 5 and chapter 6). Considering that high catastrophizing children are more dependent upon the care available through others, they might be particularly vulnerable for the impact of other's responses (Claar, Simons, & Logan, in press; Peterson & Palermo, 2004).

It is perhaps most reasonable to assume that pain catastrophizing might, essentially, be adaptive in its orientation, but might become maladaptive in the effects it may ultimately generate, especially *over time*, and both by its effects at an intrapersonal and an interpersonal level. Not the absolute level of catastrophizing might be most important, bút the specific *context* in which catastrophizing emerges (Crombez et al., 2002c; Sullivan et al., 2004a) and the extent

to which catastrophic thinking about pain *persists* across varying contexts. Contextual factors may imply particular features of the pain such as its chronicity and experienced intensity, but also features of the social context, such as the presence of others and the disposition in others to offer appropriate help and care.

CLINICAL IMPLICATIONS

The preliminary and theoretical nature of the findings discussed in the preceding chapters limits the extent to which direct clinical implications from the present findings may be drawn. Some important themes, however, have emerged that may have repercussions at a clinical level. First, the present findings further attest to the importance for assessing and targeting pain catastrophizing in children. Second, the present findings also further our understanding of conceptualizing different types of pain behaviour in terms of its differential functionality.

ASSESSING AND TARGETING PAIN CATASTROPHIZING IN CHILDREN

Both (1) the maladaptive impact pain catastrophizing may have upon pain outcomes in children (chapter 1 and 2), and (2) findings indicating that change in catastrophizing is associated with better outcome (Smeets, Vlaeyen, Kester, & Knottnerus, 2006; Spinhoven et al., 2004; Thorn, Bootbhy, & Sullivan, 2002), emphasize the importance of assessing for and targeting pain catastrophizing in children. For high catastrophizers, signals of impending pain are perceived as highly threatening and may be difficult to divert attention away from. In fact, distraction strategies may not work in high catastrpohizers (Van Damme, Crombez, Van Nieuwenborgh-DeWever, & Goubert, 2008). Most effective in targeting catastrophizing may be a diminishment of the threat value of pain by means of cognitive restructuring techniques (Thorn and Williams, 1993) or exposure techniques that disconfirm the belief of catastrophic outcomes (Crombez et al., 2002b; Vlaeyen, De Jong, Sieben, & Crombez, 2002). Assessing and targeting catastrophizing may be most useful and particularly beneficial in those children who also score high on negative affectivity and who are likely to have more stable patterns or persistent levels of future catastrophizing (chapter 1 and 2). In addition, to the extent that catastrophizing in children, by heightened display of their pain (chapter 3, 4 and 6) relates to heightened responsiveness of others in the social environment, treatment should also address the social networks of those individuals who highly catastrophize about pain (Buenaver et al., 2007; Cano, 2004).

THE DIFFERENTIAL FUNCTIONALITY OF PAIN BEHAVIOUR

Besides a focus on the importance of assessment and targeting of pain catastrophizing in children, the findings of this dissertation further add to our understanding of pain behaviour, an understanding that may be relevant for clinical purposes. Specifically, the present findings

further attest to the notion that pain behaviour is not a unitary construct (Prkachin, 1986; Sullivan et al., 2004a). Rather, pain behaviour consists of different categories that vary with different determinants and may also have differential effects upon others.

Understanding pain behaviour clearly needs to go beyond the assumption that all pain behaviour is contingent upon external contingencies; i.e. pain expression cannot be viewed solely as a function of the anticipation of e.g., positive attention or special privileges from others. The present findings indicated different types of pain behaviour may vary with varying characteristics of the pain, such as the intensity of pain and catastrophizing thoughts about the pain, as well as with characteristics of the social context, such as the presence of others. At the simplest level, no facial expression of pain does not necessarily reflect no pain (see e.g., chapter 6- stranger condition). Similarly, neither does high facial pain expression necessarily reflects high pain (see e.g., chapter 4). Understanding and tailoring care to the specific needs of an individual clearly requires an appreciation of (1) the differential indices of the pain, including verbal pain reports as well as the different types of non-verbal behavioural indices of the pain (Hadjistavropolous & Craig, 2002; McGrath, & Gillespie, 2001) and (2) understanding why and when people engage or *not* engage in certain types of pain behaviour.

LIMITATIONS

There are some methodological issues that deserve reflection. First, the child's catastrophizing was operationalized and assessed in two different ways. In chapter 1, 2, 3, and 6 the original pain catastrophizing scale for children (PCS-C; Crombez et al., 2003) was used to assess the child's level of catastrophic thinking about pain. A disadavantage of the PCS-C, however, is that the construct of catastrophizing about their pain is assessed without specification of a particular stimulus or context: i.e.children are asked to rate how frequently they experience each of the 13 thoughts and feelings when they are in pain. Accordingly, children who have high PCS-C scores might have no catastrophic thoughts about the specific types of pain assessed in our studies (see chapter 4, 5, and 6). Ajzen (1988) has described this problem as a lack of compatibility between measurements. He convincingly argued and demonstrated that a lack of compatibility between measurements has a detrimental effect upon statistical power. Therefore, we decided, based upon the original PCS-C, to design a situation-specific measure of the PCS-C that was compatible with our pain test. In chapter 4 and 5 a situation-specific measure of catastrophizing was used to asses the child's catastrophic thinking about the specific pain test. In chapter 6, however, the original PCS-C was used instead of the situation-specific measure. Here, analyses with the situation-specific measure of catastrophizing revealed similar patterns as those obtained with the PCS-C, but were less pronounced, suggesting that the situation specific measure of catastrophizing was *less* powerful to detect differences. A possibility is that the pain experience in some experiments is unfamiliar to the child. We believe this might indeed have been the case; in contrast with the experience of 'walking' (chapter 4) and 'cold water' (chapter 5), none of the children had experienced this

specific stimulus (pressure pain) before and hence had little basis for forming their beliefs or specific appraisals about the pain task.

Second, in the observational and experimental studies pain was induced, except for the 2 minute walk test (chapter 4), by means of an experimental pain procedure; i.e. cold water pain (chapter 5) and pressure pain (chapter 6). The experimental setting differs from real life situations in that it is devoid from the complex array of environmental stimuli under which pain is normally experienced. Experimental pain may also not be associated with the same degree of threat that typically accompanies the pain of injury or illness. This limits the generalizability to clinical and non-clinical or naturally occurring pain. In addition, use of two different experimental pain procedures may possibly also account for the differences in findings reported in chapter 5 and chapter 6. Specifically, whereas chapter 5 reported on an interaction effect between the child's pain catastrophizing and self-report of pain, there was no interaction effect between the level of pressure pain and the child's pain catastrophizing upon their facial display of pain in chapter 6: i.e. both high and low catastrophizing children showed increasing levels of facial pain expression with increasing levels of pressure pain. However, given the intensity of pain was experimentally and succesfully manipulated by inducing pressure above, equal to and below the child's pain threshold, the findings of chapter 6 offer a more stringent test of the specific hypothesis advanced in chapter 5.

A third limitation might concern sample size and selection bias. Specifically, there might be power problems due to the inclusion of a relatively small number of participants in the clinical samples (chapter 1, 3, and 4). It is possible that stronger effects would have been obtained by including more participants. Studies, however, that allowed comparative analyses (see chapter 1 and chapter 3) indicated associations between catastrophizing and the outcome measures of interest were similar for the clinical samples as for the samples of school children. Nevertheless, although the samples of school children were sufficiently large, caution is also needed in drawing inferences from these findings. Additional analyses indicated there were no differences on the socio-demographic variables and other variables between the group of school children who participated in the questionnaire study (chapter 3) and those who also participated in the experimental pain tests (chapter 5 and 6). However, we have no data on initial non-responders for the questionnaire studies (chapter 1 and 3). Accordingly, we cannot rule out the possibility that there might have been an initial self-selection bias. Specifically, participants' decision to participate may be correlated with traits that affect the study, making the participants a non-representative sample. For example, children or parents who have strong opinions or substantial knowledge may be more willing to spend time answering a survey than those who don't.

Fourth, the findings reported in the preceding chapters revealed that pain catastrophizing is part of the picture when it comes to understanding pain experience and pain expression in children. Nevertheless, the effect sizes of the child's pain catastrophizing upon the outcome measures were low to moderate. Although low to moderate effects do not exclude the possibility that pain catastrophizing might be more influential for some children than for others, it does reveal that other factors, both child-related factors (e.g., coping strategies), environmental

factors (e.g., parental responses), and specific characteristics of the pain (e.g., pain duration) need to be taken into account to get a fuller picture both (1) on the extent to which other factors contribute to pain outcomes, as well as (2) on the extent to which other factors might moderate the association between catastrophizing and its outcome.

Fifth, the extent to which the child engaged in different types of pain expression was measured in different ways, making comparisons across the studies reported in this dissertation, and available studies in adults, difficult. Specifically, different types of pain expression were measured by means of child-report, parent-report and different observational coding procedures. Different measures, however, may tap different dimensions of the pain experience and related behaviour. In particular, inconsistency in findings, i.e. main effects of catastrophizing upon the child's communicative pain behaviours (see chapter 3 and 4) versus the absence of such an effect (chapter 5 and 6) may therefore also be due to differences between measures. The findings reported in chapter 3 and 4 are in line with findings obtained in adults: i.e. higher levels of catastrophizing are associated with higher levels of pain expression. The findings of chapter 5 and 6, however, indicated no main effect of catastrophizing upon the facial pain expression of the child, bút they are also more difficult to compare with available findings in adults. To our knowledge, there is no study in adults that has investigated the impact of pain catastrophizing upon pain expression in presence of e.g., a spouse or another significant caregiver, neither is there a study in adults that has used a fine-grained analysis of facial pain expression such as the CFCS (Breau et al., 2001). Fine-grained coding of facial pain expressions has revealed the expression of pain is unique and distinct from prototypical facial expressions of basic emotions, such as anger, fear or disgust (see e.g., Kappesser & Williams, 2002: Simon, Craig, Gosselin, Belin, & Rainville, 2008). This is less clear for the other measures used in our studies. There is need for a continuing refinement of pain behaviours, reflected in well-validated and fine-grained measures of *diverse* types of pain expression, ánd for studies further investigating its functional taxonomy.

FUTURE RESEARCH

RECEPTIVE DIMENSIONS OF PAIN CATASTROPHIZING IN CHILDREN: UNDERSTANDING OTHER'S RESPONSES TO THE CHILD'S PAIN

Understanding interpersonal dimensions of pain, and pain catastrophizing in particular, requires appreciating both its expressive dimensions and its receptive dimensions. Specifically, one needs to understand not only (1) how pain experience becomes manifest in behaviour, but also (2) how others attend to, interpret, and respond to specific cues or the configuration of distress presented by the person in pain, and, (3) how this, in turn, impacts upon the child's future pain experience and related pain behaviour (Hadjistavropolous & Craig, 2002). To date, it is unclear what type of responses high catastrophizing children elicit in others and how, in turn, these responses influence the child's future pain experience? Research in adult populations has

indicated other's responses to high catastrophizers may vary substantially; catastrophizing appears to elicit positive responses such as the provision of instrumental support (Keefe et al., 2003), as well as negative responses such as criticising the sufferer in pain or responding punitively (Boothby et al., 2004; Keefe et al., 2003). A persistent demanding style of high catastrophizing individuals may also, in particular over time, become a source of strain, burden, frustration and distress for caregivers, and account for the latter type of responses (Cano, 2004). Although it is unclear how these responses may impact upon pain catastrophizing, it is likely that both solicitous responses and negative responses may contribute to the persistence of pain catastrophizing (Guite, Rose, McCue, Sherry, & Sherker, 2007: Sullivan et al., 2001). Solicitous responses may positively reinforce catastrophizing. Negative responses may add to the aversive experience of pain, and further increase catastrophizer's vulnerability in dealing with pain (Claar et al., in press; McCracken, 2005). Investigating how other's responses, in particular those of parents, relate to catastrophizing thoughts and associated catastrophizing behaviour of the child may shed light on important moderating and/or maintaining factors impacting upon the pain catastrophizing and its association with the child's pain experience and expression of pain.

HEIGTHENED PARENTAL SENSITIVITY AND RESPONSIVENESS TO THEIR CHILD'S PAIN: THE ROLE OF PARENTAL CATASTROPHIZING ABOUT THEIR CHILD'S PAIN

Besides investigating the type of responses pain catastrophizing in children elicits in others and how these responses impact upon the child's future pain experience, it also important to investigate who is likely to be less or more sensitive and responsive to heightened pain displays in the child. Not only characteristics of the child, such as the extent to which the child engages in pain expression, but also characteristics of the observer are important here (Goubert et al., 2005; Williams, 2002). In fact, there is a clear distinction between what is observable and how it is processed by others. Three different, yet related, elements can be distinguished in the impact of pain expression upon observing others: First, the *detection and discrimination* of available (pain) information. Second, the *meaning* attached to what has been observed. Third, the *behavioural responses* of the observer (Prkachin & Craig, 1995; Prkachin, Solomon & Ross, 2007). Specific characteristics of the observer (e.g., parent) may influence both attention to pain cues and interpretation of these pain cues, thereby having an impact upon caregiving behaviour (Hadjistavropolous et al., 1997; Pillai Riddell, Badali, & Craig, 2004). In line with the cognitive-affective model of pain, in which the interruptive function of pain is central (Eccleston & Crombez, 1999), it is highly likely that individuals who personally engage in high levels of catastrophizing (1) will be more attentive to the pain signals / cues of others (Sullivan et al., 2006b; Van Damme, Crombez, & Lorenz, 2007), (2) will estimate the pain of others to be more severe and/or interpret others' experiences more negatively (Goubert, Vervoort, Cano, & Crombez, in press; Pincus & Morley, 2001), and, consequently (3) engage in various helping behaviours that might be aimed at reducing, avoiding or escaping the other's pain. Although this might be adaptive in the short term, preliminary evidence suggests these responses have also

maladaptive consequences for the person in pain: catastrophizing thoughts in caregivers, such as spouses or parents, are associated with higher levels of functional disability, pain intensity and emotional distress in the person suffering pain (Cano et al., 2004; Goubert et al., 2005). Future studies investigating the extent to which the child's pain catastrophizing and parental catastrophizing about their child's pain interact in their effect upon the child's pain experience and related expression and upon parental detection, interpretation and responsiveness to their child's pain might yield useful insights that further our understanding of which parent-child dyads may be at most risk for deleterious pain outcomes in the child.

THE SPECIFICITIES OF THE BEHAVIOUR OF THE PERSON IN PAIN: TOWARDS A FUNCTIONAL ACCOUNT OF PAIN EXPRESSION

The term pain behaviour is often used very generally to incorporate diverse types of behaviours. Pain behaviour, however, is, like pain itself, *not* a unitary or unidimensional construct (Eccleston & Crombez, 1999; Prkachin, 1986; Williams & Craig, 2006). Pain behaviour encompasses various actions ranging from verbalizations about the pain, to non-verbal actions such as e.g., the facial display of pain, or guarding, holding, or rubbing. In addition, different types of pain behaviours may have different antecedents, different consequences and hence, serve a different function. Specifically, some behaviours, such as the facial expression of pain may primarily serve to *communicate* pain to others. Other pain behaviours, such as holding or rubbing the painful spot may primarily serve to *protect* the body from further harm and/or minimize the pain. Hence, pain behaviours may serve direct intrapersonal functions, but may also enhance interpersonal adaptation by alerting others of their pain and instigate help and care in others (Craig, 2004; Sullivan et al., 2006a; Williams, 2002). Accounts of the differential functionality of pain behaviours, however, are preliminary and definitely need further investigation. Specifically, the questions (1) why and how people show pain and (2) how others perceive and respond to the sufferer's varying pain displays needs to be investigated more thoroughly (Williams & Craig, 2006). Addressing the first question requires taking into account various kinds of pain expression as well as assessment of varying determinants or antecedents. In addition, alternative methods of assessing pain behaviour, such as the method used by Tang et al. (2007; see chapter 4) might hold promise in furthering our understanding of the subtle differences in pain behaviours between persons and the person's underlying meanings or motivations for these behaviours. In addition to understanding how and why people show pain, understanding the nature of the interaction between the sufferer's diverse pain behaviours and those able to provide care is essential. Specifically, judgments and decisions of others determine whether and which interventions will be made available. Accordingly we need to know how observers, from the broad range of cues arising from witnessing another person in pain, make judgments and decide upon care to be delivered (Goubert, Craig, & Buysse, in press) and, whether these interventions, in turn, are carefully tailored to the specific needs of the individual in pain. Hence, it is important to address not only

what the various types of pain expression *mean* to the sufferer in pain but also what the various types of pain expression *communicate* to others. Although the prominence of the facial display of pain as a source of pain information among the various channels of non-verbal pain communication is well established (see e.g., Kappesser et al., 2006; Sullivan et al., 2006a), all behaviours may, to a varying extent, cue pain to others. In addition, the perception of pain is more than an estimate of other's pain *intensity*. In fact, perceiving other's in pain may be a complex cognitive and emotional appreciation of the pain-related thoughts, feelings, needs and motives of the sufferer in pain (e.g., appreciation of the sufferer's capability of dealing with pain or need for help). It is these complexities of pain behaviour, both from the sufferer's, as well as from the observer's point of view, that we need to address in order to come to a more comprehensive understanding of pain as a social phenomenon.

THE INTERPERSONAL ORIENTATION OF PAIN CATASTROPHIZING: TOWARDS AN UNDERSTANDING OF ITS ORIGINS

Ultimately remaining is the question *why* catastrophizing relates with an expressive and interpersonal orientation towards dealing with pain and whether this is *primarily* the case (see Sullivan et al., 2001). The findings that women (1) catastrophize more than men (Bédard et al., 1997; Crombez et al., 2003; Hermann et al., 2007; Keefe et al., 2000; Osman et al., 1997; Sullivan et al., 1995) and (2) are more socially-oriented and more expressive in dealing with their pain (Fearon et al., 1996; Keogh & Eccleston, 2006; Keogh & Herdenfeldt, 2002; Tamres, Janicki, & Helgeson, 2002; Unruh, 1996), have contributed to the conceptualisation of catastrophizing within a context of seeking or demanding help (Sullivan et al., 2001). Yet, explanations remain at a descriptive and static level, and do not elucidate the underlying processes of why, for instance, women catastrophize more than men and why women engage in more socially-oriented strategies in dealing with their pain. Particularly interesting is the suggestion that factors contributing to the development of catastrophizing may be similar to those that give rise to gender differences in pain experience and pain expressiveness (Sullivan et al., 2001).

Social contexts may be important determinants of the nature of the pain experience of boys and girls and how they express pain. Gender differences, for example, might be shaped by differences by which a child is socialized to think about pain and behave when in pain (Craig et al., 2006; Fearon et al., 1996; Hatchette, 2005; Zeman & Garber, 1996), as well as by differential caregiving behaviours (Fearon et al., 1996: Walker & Zeman, 1992) or differential expectations regarding social roles (Keefe et al., 2000; Unruh & Campbell, 1999; Wise, Price, Myers, Heft, & Robinson, 2007). In addition, families may also influence children's experiences of pain through family members' own experiences of pain and use of coping strategies in dealing with their own pain (Goodman & McGrath, 2003; Schanberg et al., 2001; Thastum, Zachariae, Scholer, Bjerring, Herlin, 1997). Children may learn about pain, in part by observing the behaviour of significant role models when in pain. In line with this view are findings

indicating that children who live in families with painful conditions become more reliant on catastrophizing about their own pain (Schanberg et al., 2001). This may perhaps be particularly true for girls, as they might be more responsive to social influences as compared to boys (Unruh & Campbell, 1999).

In sum, the experience of pain, considered to be an archetypal sign of threat, may become even more threatening both by the way caregivers' respond to the expression of pain of the child as well as via pain expressive behaviours of others that are observed by the child. Both the expression of pain as the extent to which one catastrophizes about pain may thus be related to how girls and boys learn to appraise and give threatening meaning to pain, learning that may have origins in early *interpersonal* life experiences. As such, catastrophic thinking about pain might originate from and be intrinsically intertwined with its social environment. Whether catastrophizing therefore also functions primarily via its effects upon the social environment needs to be examined. The low effects (or even no effects) of the child's catastrophizing upon pain expression in the studies presented in this dissertation, suggests demanding other's help by heightened communicative expression of pain may not be the primary route for *all* high catastrophizing children. Catastrophizing may also simultaneously influence pain outcomes through its effect upon the child's intra-individual affective-motivational response to pain, as well as, by overt display of their pain thereby impacting upon other's way of responding to their pain. Alternatively, heightened social support seeking and pain expressiveness in high catastrophizers may eventually also result from accumulating individual failures to escape or avoid persistent pain, and hence, constitute a secondary route. Here, investigating how specific environmental conditions (e.g.,, presence of a potential caregiver; being in a help-seeking context/setting or a specific history of social responses), characteristics of the pain (e.g., escapable or not) and different components of catastrophizing (i.e helplessness, rumination, and magnification) contribute to and/or interact in explaining differential routes to pain outcomes will further our understanding of the mechanisms accounting for the specifics of the relationship between catastrophizing and pain.

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NEDERLANDSTALIGE SAMENVATTING

Pijn komt vaak voor, zowel bij volwassenen (Picavet & Schouten, 2003) als bij kinderen (Perquin et al., 2000). De meeste pijnervaringen zijn van korte duur en niet problematisch. Er is evenwel een klein maar significant aantal kinderen waarbij pijn persisteert en/of waarbij pijn aanleiding geeft tot een hoge mate van beperkingen en emotionele ontreddering voor het individu in pijn én diens sociale omgeving (Drotar, 1992; Gauntlett-Gilbert & Eccleston, 2007; Palermo, 2000). De intensiteit van de pijn of de ernst van het letsel zijn evenwel vaak onvoldoende om de mate van hinder en ontreddering te verklaren. Onderzoek heeft aangetoond dat de mate waarin personen *catastroferen over pijn* een belangrijke psychosociale voorspeller is van de manier waarop personen met pijn omgaan en bijgevolg een belangrijk construct is in het begrijpen van pijnervaringen. Catastroferen over pijn is een cognitief-affectieve reactie gekenmerkt door een overmatig negatieve interpretatie van pijn, piekeren over pijn en het negatief evalueren van de eigen mogelijkheid om om te gaan met de pijn (Sullivan, Bishop, & Pivik, 1995; Sullivan et al., 2001). In normale omstandigheden kan piekeren over de pijn en het percipiëren van pijn als bedreigend adaptief zijn door het opeisen van de aandacht van het individu in pijn en het faciliteren van gedrag gericht op het vermijden of ontsnappen aan de pijn (Crombez et al., 2003; Eccleston & Crombez, 2007). Wanneer pijn echter chronisch wordt kan catastroferen over de pijn een perseveratieve en maladaptieve strategie worden die emotionele ontreddering en hypervigilantie voor pijn verder aanwakkert (Eccleston & Crombez, 1999; 2007). Catastroferen is tot nog toe voornamelijk onderzocht bij volwassenen. Uit tal van studies, in klinische en niet-klinische volwassen populaties, blijkt dat catastroferen over pijn gerelateerd is aan negatieve pijnuitkomsten zoals o.a. meer pijn, meer functionele beperkingen en emotionele ontreddering zoals gevoelens van depressie en angst (Sullivan et al., 2001).

Het onderzoek dat uitgevoerd werd bij kinderen is in lijn met bevindingen bij volwassenen en beklemtoont aldus het belang van het onderzoek naar de rol van catastroferen bij pediatrische populaties. Net zoals bij volwassenen is de mate waarin kinderen catastroferen over hun pijn positief gerelateerd met pijn, functionele beperkingen en emotionele ontreddering (Crombez et al., 2003; Hermann, Hohmeister, Zohsel, Ebinger, & Flor, 2007; Kashikar-Zuck, Goldschneider, Powers, Vaught, & Hershey, 2001). Onderzoek bij kinderen is evenwel schaars en de *unieke* rol van catastroferen in het verklaren van pijnuitkomstmaten dient verder onderzocht te worden. Meer in het bijzonder is het onduidelijk in welke mate meer stabiele persoonlijkheidskenmerken van het kind, zoals de mate van negatieve affectiviteit (Costa & McCrae, 1992) een verklaring kunnen bieden voor de effecten van catastroferen over pijn.

Recent onderzoek bij volwassenen toont aan dat catastroferen over pijn belangrijke sociaal-gedragsmatige dimensies heeft en bijgevolg niet louter als intra-individele ervaring te begrijpen is. Sullivan et al. (2001) suggereerde dat catastroferen over pijn kan geconceptualiseerd worden als een primair *interpersoonlijke orientatie* in het omgaan met pijn; i.e. catastroferen vraagt niet enkel de aandacht van de persoon in pijn, maar, doorheen pijnexpressieve gedragingen, eveneens de aandacht en mogelijke zorg of hulp van anderen. In lijn met deze visie zijn

onderzoeksbevindingen bij volwassen die aantonen dat catastroferen geassocieerd is met hogere niveau's van pijnexpressieve gedragingen en een hogere responsiviteit van hun sociale omgeving zoals gereflecteerd in het verschaffen van steun (zie bvb. Keefe et al., 2003; Buenaver, Edwards, Haythornthwaite, 2007) maar ook negatieve consequenties zoals straffende reponsen (Boothby, Thorn, Overduin, & Ward, 2004). Bijgevolg lijkt het aannemelijk dat de invloed van catastroferen op de individuele pijnervaring eveneens verloopt via de effecten die catastroferen genereert op de social omgeving (Sulivan et al., 2001). Onderzoek naar de interpersoonlijke dimensie van catastroferen over pijn bij kinderen en adolescenten is vooralsnog niet aanwezig. Echter, de interpersoonlijke rol van catastroferen over pijn kan uitermate belangrijk zijn bij kinderen en adolescenten. Kinderen zijn in sterke mate afhankelijk van de zorg van anderen, in het bijzonder van de zorg van hun ouders die de primaire verantwoordelijkheid dragen over hun kind en belangrijke figuren zijn in de socializatie en betekenisverlening van pijnervaringen bij hun kind (Craig, Stanford, Fairbairn, & Chambers, 2006; Palermo & Chambers, 2005).

In dit proefschrift zijn een aantal studies beschreven waarin onderzocht werd in welke mate catastroferen over pijn bij kinderen en adolescenten bijdraagt (1) aan het verklaren van pijnuitkomstmaten zoals pijn en functionele beperkingen (deel I- hoofdstuk 1 en 2) en (2) pijn expressieve gedragingen van het kind (deel II- hoofdstuk 3, 4, 5, en 6).

In **Hoofdstuk 1** van dit proefschrift worden twee cross-sectionele vragenlijststudies gerapporteerd; één studie bij schoolkinderen (n = 193) en een tweede studie in een klinische steekproef van kinderen en adolescenten met chronische of recurrente pijn (n = 43). In beide studies werd onderzocht wat de unieke rol is van catastroferen over pijn in het verklaren van pijnintensiteit, functionele beperkingen en somatische klachten bij het kind. Er werd eveneens nagegaan in welke mate de effecten van catastroferen over pijn bij het kind specifiek zijn voor catastroferen en niet kunnen verklaard worden door negatieve affectiviteit van het kind. In het bijzonder, wanneer condities voor mediatie vervuld waren (zie Holmbeck, 2002), werd onderzocht in welke mate catastroferen over pijn de relatie tussen negatieve affectiviteit en de uitkomstmaten medieerde. De resultaten toonden aan dat, voor beide steekproeven, catastroferen over pijn een substantiële bijdrage had in het verklaren van somatische klachten, pijn en functionele beperkingen, na controle voor de effecten van negatieve affectiviteit. Voor beide studies bleek dat het effect van negatieve affectiviteit klein of onbestaande was. Bovendien, de relatie tussen negatieve affectiviteit en somatische klachten in de steekproef van schoolkinderen en de klinische steekproef en de relatie tussen negatieve affectiviteit en functionele beperkingen bij schoolkinderen werd sterk gemedieerd door de mate waarin het kind catastrofeerde over pijn. Deze bevindingen tonen aan dat de variabiliteit in pijnuitkomstmaten bij het kind niet kunnen verklaard worden door de mate van negatieve affectiviteit van het kind, maar functie zijn van specifieke cognitief-affectieve factoren zoals catastroferen over de pijn. De cross-sectionele opzet van de studies laat evenwel geen uitspraken toe over de richting van de verbanden.

In **Hoofdstuk 2** werd evidentie gezocht voor de antecedente status van catastroferen over pijn in het voorspellen van pijnuitkomstmaten bij kinderen. Meer in het bijzonder werd nagegaan in welke mate catastroferen over pijn en negative affectiviteit bij schoolkinderen (*n* = 323) een voorspeller is van pijn en functionele beperkingen 6 maand later. Gegeven de significante rol van pijnintensiteit voor latere pijn en beperkingen (Claar & Walker, 2006), onderzochten we eveneens of de relatie tussen catastroferen en pijn en functionele beperkingen 6 maand later gemodereerd werd door de initieel gerapporteerde pijnintensiteit van het kind. Daar hogere niveau's van pijn, in vergelijking met lage pijnintensiteit, minder waarschijnlijk zijn om onopgemerkt te blijven en bijgevolg meer kans hebben te interfereren met het dagdagelijse leven van het kind, verwachtten we dat de effecten van catastroferen het sterkst uitgesproken zouden zijn bij lagere niveau's van pijn. Tenslotte werd in deze studie ook nagegaan in welke mate negatieve affectiviteit bij het kind een voorloper is voor de mate waarin het kind catatstrofeert over pijn. Deze studie toonde opnieuw aan dat de effecten van catastroferen over pijn niet konden verklaard worden door negatieve affectiviteit bij het kind. Catastroferen over pijn had een klein, maar uniek effect op pijn en functionele beperkingen 6 maand later, zelfs na controle voor de initiële pijn en beperkingen van het kind. De effecten van catastroferen waren echter het meest uitgesproken voor deze kinderen die lage niveau's van pijn rapporteerden bij de baseline meting. Negatieve affectiviteit blijkt vooral belangrijk te zijn als voorloper van catastroferen over pijn: i.e. kinderen die hoog scoren op negatieve affectiviteit zijn meer geneigd om te catatstroferen over pijn 6 maand later. Deze bevindingen zijn in lijn met resultaten uit studies bij volwassenen waarbij eveneens werd aangetoond dat de effecten van catastroferen niet verklaard kunnen worden door negatieve affectiviteit. Negatieve affectiviteit blijkt ook bij volwassenen een kwetsbaarheidsfactor te zijn voor catastroferen (Goubert, Crombez, & Van Damme, 2004). Echter, in tegenstelling tot bevindingen bij volwassenen vonden we dat de stabiliteit van catastroferen over pijn bij kinderen, over een periode van 6 maanden, slechts matig is (*r*= .42).

Hoofdstuk 1 en 2 brachten verdere evidentie voor de rol van catastroferen over pijn bij kinderen en adolescenten in het verklaren van pijnuitkomstmaten. De daaropvolgende hoofstukken (hoofdstuk 3 t.e.m. hoofdstuk 6) hadden als doel te onderzoeken in welke mate catastroferen over pijn bij het kind bijdraagt in het verklaren van pijnexpressieve gedragingen. Meer in het bijzonder werden in de studies gerapporteerd in hoofdstuk 3 en hoofdstuk 4 onderzocht welke de relatie is tussen catastroferen en verschillende types of vormen van pijngedrag. Een onderscheid werd gemaakt tussen gedragingen die een primair communicatieve functie vervullen (bvb. verbalisaties over de pijn en faciale pijnexpressie) en pijngedragingen waarvan men verondersteld dat ze een primair protectieve functie vervullen (bvb. wrijven over de pijnlijke plaatsen) (zie Hadjistavropolous & Craig, 2002; Sullivan, Martel, Savard, & Crombez, 2006). De studies gerapporteerd in hoofdstuk 5 en 6 onderzochten de modererende rol van catastroferen in het verklaren van faciale pijnexpressie bij het kind.

In **Hoofdstuk 3** werd een cross-sectionele vragenlijststudie gerapporteerd waarbij nagegaan werd welke de rol is van catastroferen in het verklaren van (1) de tendens van het kind om pijn

te verbalizeren naar anderen en (2) de perceptie van moeder en vader van verschillende vormen van pijngedrag van hun kind, waaronder verbale en non-verbale pijnexpressie, en protectieve pijngedragingen. Deelnemers van dit onderzoek waren schoolkinderen (*n* = 659) en hun ouders (*n* = 632 moeders en 484 vaders) en kinderen met chronische of recurrente pijn (*n* = 61) en hun ouders (*n* = 52 moeders en 34 vaders). Inclusie van twee steekproeven liet toe verschillen tussen beide eveneens te onderzoeken. De resultaten toonden aan dat kinderen die hoger scoren op catastroferen over pijn in sterkere mate hun pijn naar anderen verbaliseren in vergelijking met kinderen die minder catastroferen over hun pijn. Catastroferen van het kind was ook positief geassocieerd met ratings van moeder én vader van verbale en non-verbale communicatieve pijngedragingen en ratings van vader van protectieve pijngedragingen bij het kind. Er waren evenwel enkele verschillen tussen beide steekproeven: kinderen van de klinische steekproef rapporteerden meer pijn, meer catastroferen, meer protectieve pijngedragingen maar minder verbale communicatie over hun pijn in vergelijking met de groep schoolkinderen. Echter, de rol van catastroferen in het verklaren van verschillende vormen van pijngedrag verschilde niet tussen beide steekproeven.

Hoofdstuk 4 beschrijft een observationele studie waarbij onderzocht werd in welke mate catastroferen bijdraagt aan het verklaren van verschillende vormen van pijngedrag bij een groep adolescenten (*n* = 38) met chronische pijn die een pijnlijke test uitvoerden. Adolescenten werden geobserveerd op video tijdens het uitvoeren van een '2 Minute Walk Test' (2MWT). Dit liet toe faciale pijnexpressies en protectieve pijngedragingen van de adolescent te coderen. Aan ouders werd gevraagd, enkele uren na afloop van de 2MWT, aan te geven in welke mate hun kind zijn/haar pijnervaringen naar hen toe had geverbaliseerd. Resultaten van deze studie gaven aan dat hogere niveau's van catastroferen over pijn geassocieerd waren met hogere niveau's van communicatieve pijngedragingen (verbalisaties en faciale pijnexpressie), maar niet met protectieve pijngedragingen. Protectieve pijngedragingen, maar niet communicatieve pijngedragingen waren positief geassocieerd met de gerapporteerde pijnintensiteit van de adolescent.

De bevindingen gerapporteerd in dit hoofdstuk en het voorafgaande hoofdstuk toonden aan dat catastroferen over pijn bij kinderen en adolescenten consistent lijkt bij te dragen in het verklaren van een hogere mate van *communicatieve* pijnexpressieve gedragingen. Er zijn evenwel nog andere factoren die een invloed kunnen hebben op de mate van pijngedrag. Zowel kenmerken van de pijn als kenmerken van de sociale context kunnen hun invloed doen gelden. In hoofdstuk 5 en 6 beargumenteerden we evenwel dat catastroferen een belangrijke factor kan zijn in het modereren van het effect van zowel gerapporteerde pijnintensiteit (hoofdstuk 5) en ouderlijke aanwezigheid (hoofdstuk 6) op de faciale expressie van pijn.

De bevindingen in **Hoofdstuk 5** rapporteerden over een observationele studie bij schoolkinderen (*n* = 62) en hun ouders (*n* = 50 moeders en 12 vaders). In deze studie onderzochtten we in welke mate catastroferen een impact heeft op de relatie tussen gerapporteerde pijnintensiteit en faciale expressie van pijn. We verwachtten dat (1) voornamelijk voor laag catastroferende kinderen, faciale pijnexpressie positief geassocieerd zou

zijn met de gerapporteerde pijn en dat (2) hoog catastroferende kinderen meer faciale pijnexpressie zouden tonen ongeacht het niveau van ervaren pijn. De kinderen namen deel aan een pijnlijke procedure, i.e. de koudwatertaak. De kinderen werden tijdens deze pijnlijke test geobserveerd door hun moeder of vader. In dit onderzoek werd de modererende rol van catastroferen onderzocht voor de relatie tussen gerapporteerde pijn van het kind en de mate van faciale pijnexpressie van het kind. Daarnaast werd eveneens geëxploreerd in welke mate de impact van catastroferen en gerapporteerde pijn op faciale pijnexpressie gereflecteerd is in ouderlijke inschattingen van de pijn van hun kind. De resultaten van dit onderzoek toonden aan dat hogere niveau's van pijnintensiteit geassocieerd waren met hogere niveau's van faciale pijnexpressie. Dit was echter enkel het geval voor kinderen die lage niveau's van catastroferen rapporteerden. Kinderen die hoog scoorden op catastroferen toonden evenveel faciale pijnexpressie ongeacht of hun gerapporteerde pijnintensiteit laag of hoog was. Een gelijkaardig patroon werd gevonden voor ouderlijke inschattingen van de pijn van hun kind; pijn ratings van het kind waren positief geassocieerd met ouderlijke inschattingen van de pijn van hun kind, maar enkel voor laag catastroferende kinderen. Echter, en in tegenstelling met de verwachtingen, faciale pijnexpresie van hoog catastroferende kinderen was niet hoger dan pijnexpressie van laag catastroferende kinderen. Voor hoog gerapporteerde pijn toonden hoog catastrofeerders zelfs minder faciale pijnexpressie in vergelijking met laag catastrofeerders. Dit patroon was in tegenstelling met ouderlijke inschattingen van de pijn van hun kind; ouders van hoog catastroferende kinderen schatten de pijn van hun kind hoger in dan ouders van laag catastroferende kinderen, maar enkel indien het kind lage pijn rapporteerde. De bevindingen van deze studie suggereren dat hoog catastroferende kinderen niet noodzakelijk meer pijn tonen dan laag catastrofeerders, maar voornamelijk indiscriminant zijn in het tonen van verschillende niveau's van pijn. Bovendien blijkt, hoewel niet gereflecteerd in het patroon van faciale pijnexpressie, dat ouders van hoog catastroferende kinderen gealarmeerd worden bij lage niveau's van pijn.

Een laatste studie, gerapporteerd in **Hoofdstuk 6** onderzocht in welke mate catastroferen over pijn de relatie tussen ouderlijke aanwezigheid en faciale pijnexpressie bij het kind modereert. Schoolkinderen (n = 84) ervaarden verschillende niveau's van drukppijn (boven, gelijk en onder de pijndrempel) in één van twee condities. In één conditie werden de kinderen geobserveerd door hun ouder (n = 53). In de andere conditie werden kinderen geobserveerd door een vreemde (n = 31). We verwachtten dat kinderen meer pijn zouden tonen in aanwezigheid van hun ouder dan in aanwezigheid van een vreemde. In de mate dat ouders blootgesteld zijn geweest aan voorgaande pijnexpressie van hoogcatastroferende kinderen en daarbij een mogelijke instandhoudende rol vervulden, verwachtten we dat dit effect het meest uitgesproken zou zijn voor hoog catastroferende kinderen (Sullivan et al., 2001). De resultaten van deze studie toonden echter aan dat kinderen evenveel pijnexpressie toonden in aanwezigheid van hun ouder dan in aanwezigheid van een vreemde. Deze relatie werd echter significant gemodereerd door de mate waarin het kind catastrofeerde over pijn; kinderen toonden wel meer faciale pijnexpressie in aanwezigheid van hun ouder dan in aanwezigheid van

een vreemde, maar enkel indien het kind laag scoorde op catastroferen over pijn. Faciale pijnexpressie van hoog catastroferende kinderen was invariant ongeacht de relationele status van wie hen observeerde: i.e. hun ouder of een vreemde. Hoewel er, opnieuw, geen hoofdeffect was van catastroferen op faciale pijnexpressie van het kind, toonden analyses aan dat, in aanwezigheid van een vreemde, de faciale pijnexpressie van hoogcatastroferende kinderen significant hoger was dan faciale pijn expressie van laagcatastroferende kinderen. De faciale pijnexpressie van hoog en laag catastroferende kinderen verschilde niet in aanwezigheid van hun ouder. De resultaten van deze studie generaliseerden over alle niveau's van drukpijn (druk boven, gelijk en onder de pijndrempel).

Naast een samenvatting van de resultaten van de studies gerapporteerd in dit proefschrift, biedt de algemene discussie een bediscussiëring van de resultaten tegen de achtergrond van relevante onderzoeksliteratuur aangaande catastroferen over pijn en de expressie van pijn. In de algemene discussie wordt verder aandacht besteed aan enkele klinische implicaties en worden de resultaten van de studies eveneens gekaderd in het licht van mogelijke methodologische tekortkomingen of beperkingen. Tenslotte werden enkele richtlijnen voor toekomstig onderzoek geformuleerd.

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