ATTENTIONAL PROCESSES IN PARENTS OF PEDIATRIC PATIENTS WITH CHRONIC ABDOMINAL PAIN AND PARENTS OF PAIN-FREE CHILDREN

By

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CHAPTER I

INTRODUCTION

Pediatric Chronic Abdominal Pain

Abdominal pain is a common experience for children and adolescents. An extensive community-based study identified more than 40% of children between the ages of four and eighteen years as reporting abdominal pain in the preceding three-month period (Roth-Isigkeit, Thyen, Stoven, Schwarzenberger & Schmucker, 2005), and another community-based study reported that greater than 70% of middle and high school students had experienced abdominal pain in the previous year (Hyams, Burke, Davis, Rzepski & Andrulonis, 1996). Other recent studies have found that, among youth reporting chronic pain, abdominal pain was the primary complaint for 33% of children and 16% of adolescents (Hunfeld, et al., 2001; Hunfeld et al., 2002). These findings suggest that most youth experience abdominal pain at some point during childhood or adolescence.

For a subset of young people, episodes of abdominal pain become chronic, persisting over the course of several months. In fact, one large, community-based study concluded that abdominal pain was the most common chronic pain complaint among children under the age of eight years, as reported by their parents (Perquin et al, 2000). The potential negative impact of chronic abdominal pain (CAP) on the well-being of children and adolescents is widely appreciated in the medical community (e.g., Berger, Gieteling & Benninga, 2007), as CAP patients often experience comorbid psychosocial

challenges both during childhood and later in life (e.g., Campo et al., 2001; Campo et al., 2004; Garber, Zeman & Walker, 1990; Hotopf, Carr, Mayou, Wadsworth & Wessely, 1998; Walker, Garber & Greene, 1993; Walker, Garber, Van Slyke & Greene, 1995). The current study begins with an overview of the definition, prevalence, and psychosocial impact of CAP.

Definition of Chronic Abdominal Pain

Chronic abdominal pain (CAP) has long been acknowledged as a common complaint of childhood. Indeed, decades of research inform current approaches to pain and symptom management for pediatric CAP patients. Much of this research has focused on children whose abdominal pain complaints are consistent with Apley and Naish's seminal description (1958) of recurrent abdominal pain. Apley and Naish (1958) described recurrent abdominal pain (RAP) as three or more episodes of pain severe enough to disrupt usual activities occurring over the course of three or more months. It is now widely accepted that this broad definition has obscured meaningful heterogeneity among children and adolescents with CAP. A recent report prepared by the American Academy of Pediatrics and the North American Society for Pediatric Gastroenterology, Hepatology and Nutrition Committee on Chronic Abdominal Pain concluded that, "Recurrent abdominal pain, as a case definition, includes children with a variety of functional gastrointestinal disorders causing abdominal pain, such as nonulcer dyspepsia, IBS or abdominal migraine. It also may include children with organic disease" (Di Lorenzo et al., 2005b). Subsequently, the Committee has recommended that the term "recurrent abdominal pain" no longer be used clinically or in research literature, and has

recommended that the term “chronic abdominal pain” be used to describe, “long-lasting, intermittent or constant abdominal pain that is functional or organic” (Di Lorenzo et al., 2005a). Consequent to the use of different criteria for describing primary complaints of abdominal pain as RAP or CAP in the literature, the exact prevalence of CAP remains unknown (Di Lorenzo et al., 2005b).

Prevalence of Chronic Abdominal Pain

There is considerable variability in estimated prevalence rates for pediatric CAP. A recent review of fourteen published studies found that individual studies reported prevalence rates between 0.3% and 19% (Chitkara, Rawat & Talley, 2005). Based on their review, Chitkara and his colleagues concluded that the median prevalence of CAP across existing studies was 8.4%. A large community-based study published after this review reported findings consistent with those of Chitkara and his colleagues. Specifically, 10% of females and 5% of males between the ages of nine and fifteen years reported abdominal pain weekly or more often over a three-month period (Sundblad, Saartok & Engström, 2007).

Recognition that chronic abdominal pain (CAP) is a common symptom that may reflect unique underlying biological mechanisms (Di Lorenzo et al., 2005b; Walker, 1999a) has resulted in efforts to identify distinct subgroups within the heterogeneous group of CAP patients. For example, the development of standardized symptom-based criteria for pain-related pediatric functional gastrointestinal disorders (FGIDs) (Rasquin et al., 2006; Rasquin-Weber et al., 1999) has facilitated the identification of specific FGIDs among CAP patients. To date, the estimated prevalence of pain-related FGIDs

among patients seen in tertiary care clinics for CAP ranges from 68% to 89%, based on parents' reports of their children's symptoms (Baber, Anderson, Puzanovova & Walker, in press; Schurman et al., 2005; Walker et al., 2004). The use of standardized measures to differentiate subgroups of youth with CAP may facilitate more exact prevalence estimates of both CAP and underlying conditions characterized by CAP.

Psychosocial Impact of Chronic Abdominal Pain

The large body of literature concerning psychosocial characteristics of children with CAP and their families has been guided primarily by the Apley and Naish standard (Apley & Naish, 1958). Increasing recognition of the heterogeneity among CAP patients necessitates determining the relevance of this existing literature to emerging patient subgroups. To date, the relevance of the existing literature is informed by several studies that have compared psychosocial characteristics of CAP patients with and without identified organic disease and failed to reveal statistically significant differences between these groups (Di Lorenzo et al., 2005b; Scharff, 1997). For example, an early study found that pediatric CAP patients with and without identified disease were characterized by similar rates of psychiatric diagnoses (Garber et al., 1990). Subsequent studies have reported that CAP patients without identified disease and CAP patients with known organic disease (peptic disease, ulcers and inflammatory bowel disease) reported similar levels of anxiety and depression (Kaufman et al, 1997; Walker et al., 1993; Walker & Greene, 1989), which were elevated in comparison to healthy children (Walker & Greene, 1989). Furthermore, the relevance of the existing literature regarding psychosocial correlates of CAP to heterogeneous patient groups is suggested by evidence

that patients whose CAP can be attributed to distinct underlying symptom patterns do not reliably differ in their psychosocial characteristics. Specifically, a recent study of CAP patients who met criteria for functional dyspepsia, irritable bowel syndrome or functional abdominal pain failed to find significant differences in reported levels of pain, somatic symptoms, internalizing or externalizing problems, or functional impairment between groups (Robins, Glutting, Shaffer, Proujansky & Mehta, 2005).

The absence of statistically significant differences in psychosocial characteristics of CAP patients with and without identified organic disease does not necessarily establish that all children with CAP experience equivalent levels of psychological and physical impairment. Rather, these findings suggest that CAP without a known organic etiology cannot be distinguished from CAP with a known organic etiology or CAP associated with specific FGIDs solely on the basis of psychosocial factors (see Garber et al., 1990). If psychosocial factors do not adequately distinguish between patients with CAP related to different underlying conditions, then findings illuminating the psychosocial impact of CAP can be considered relevant across the broad spectrum of pediatric patients presenting with this symptom. While individual patients may exhibit particular psychosocial characteristics to a greater or lesser degree than the group of CAP patients as a whole, the existing literature retains relevance in informing a general picture of the impact of pediatric CAP. The association of CAP with psychological symptoms and functional impairment are of particular relevance to the current study.

CAP and psychological symptoms. Internalizing psychological symptoms are common among young people with CAP (Di Lorenzo et al., 2005b). In fact, numerous

studies have reported that pediatric CAP patients are rated by their parents as having more internalizing problems than healthy children (Campo et al., 2004; Dorn et al., 2003; Garber et al., 1990; Kaufman et al., 1997; Walker et al., 1993; Walker & Greene, 1989; Wasserman, Whitington, & Rivara, 1988). In particular, CAP has been associated with increased symptoms of anxiety. CAP patients experience higher levels of trait anxiety than their healthy peers, according to both self-report (Campo et al., 2004; Hodges, Kline, Barbero & Woodruff, 1985; Walker et al., 1993; Walker & Greene, 1989) and parents' report (Robins, Schoff, Glutting & Abelkop, 2003). Furthermore, CAP patients have reported elevated levels of state anxiety during study participation, higher than those of healthy peers and similar to those of pediatric patients receiving treatment for anxiety disorders (Dorn et al., 2003). Several studies also have reported higher levels of depressive symptoms in pediatric CAP patients than in healthy youth (Campo et al., 2004; Robins et al., 2003; Walker et al., 1993; Walker & Greene, 1989).

Internalizing symptoms reported by CAP patients often reach levels of clinical significance. Indeed, the rate of psychiatric diagnosis is higher among CAP patients than healthy controls, with well-controlled studies identifying psychiatric disorders in 81% (Campo et al., 2004) to 100% (Garber et al., 1990) of CAP patients. Early research found that more than 70% of patients with CAP met DSM-III criteria for overanxious disorder (Garber et al., 1990). A recent study's results were consistent with this finding: more than 70% of CAP patients presenting to primary care and tertiary clinics met criteria for a current anxiety disorder (Campo et al., 2004). Moreover, 43% of CAP patients in the study by Campo and his colleagues met criteria for current or lifetime incidence of depressive disorder, and there was considerable overlap of clinically significant anxiety

and depression. Specifically, 94% of children who met criteria for a depressive disorder also met criteria for an anxiety disorder, based on psychiatric diagnostic interview (Campo et al., 2004).

While there is consistent evidence for an association between CAP and symptoms of anxiety and depression, it bears acknowledgment that several studies have failed to support this relation. For example, two studies reported no differences in depressive symptoms reported by CAP patients and healthy children (Hodges, Kline, Barbero & Flanery, 1985; Olafsdottir, Ellertsen, Berstad & Fluge, 2001). One of these studies also failed to find group differences between CAP patients and healthy schoolchildren on parents' reports of children's anxiety symptoms (Olafsdottir et al., 2001). These findings may reflect under-reporting of emotional symptoms. Recent research shows that reports of emotional symptoms are more susceptible to social desirability influences than reports of disability or somatic symptoms among pediatric pain patients (Logan, Claar & Scharff, in press). It is possible that some parents and children pursuing specialized assessment and treatment of children's pain complaints minimize children's emotional symptoms in order to legitimize physical pain complaints (Claar, Simons & Logan, in press). Despite a small number of studies that fail to support the relation between CAP and internalizing symptoms, the comorbidity of CAP with symptoms of anxiety and depression is well-established in the existing literature.

CAP and functional impairment. Many CAP patients exhibit functional impairment, including school absenteeism or restriction of other daily activities, during pain episodes. For example, children with CAP are more frequently absent from school

than pain-free children (Hodges, Kline, Barbero & Woodruff, 1985; Kaufman et al., 1997; Robinson, Alverez & Dodge, 1990). In fact, results of a large community-based study revealed that greater than 50% of children reported that they had missed school during an episode of abdominal pain, compared to 43% percent of children with headaches and fewer than 20% of children with back pain (Roth-Isigkeit et al., 2005). Additionally, pediatric CAP patients report significantly greater impairment on a broad measure of functional disability than do patients with psychiatric diagnoses or healthy peers (Walker et al., 1993), and a large community-based study found that nearly 50% of children with abdominal pain reported that pain episodes restricted activities with friends (Roth-Isigkeit et al., 2005). Furthermore, recurrent pain impacts children's abilities to complete household chores and participate in family activities (Bennett, Huntsman & Lilley, 2000).

For some CAP patients, functional impairment associated with CAP may initiate a self-perpetuating cycle that results in increasingly negative outcomes over time. As described by Walker (1999b), when children become functionally disabled, they miss opportunities to develop academic and social competence. These missed developmental opportunities consequently have a negative impact on social and emotional functioning. Impaired social and emotional functioning decrease subsequent engagement in developmentally typical activities, and the cycle of negative effects is maintained (Walker, 1999b). The existence of this downward spiral is supported by studies showing that, among adolescents with chronic pain, greater functional disability is associated with lower levels of competence in multiple domains, including academic, athletic, and social functioning (Claar, Walker & Smith, 1999; Gauntlett-Gilbert & Eccleston, 2007). This

spiral may eventually result in pain associated disability syndrome (PADS), which is characterized by significant pain-related functional impairment that persists despite the use of pain-management strategies and may necessitate the use of intensive rehabilitation services (Bursch, Walco & Zeltzer, 1998; Hyman et al., 2002). To date, the frequency of PADS among CAP patients has not been identified.

Perhaps reflecting eventual outcomes of the cycle of impaired functioning and declining competence, CAP during childhood is associated with poor psychosocial outcomes in adulthood. For example, adults with histories of pediatric CAP report more frequent abdominal pain, more somatic symptoms, greater pain-related physical impairment, more symptoms of anxiety and depression, greater likelihood of psychiatric disorder, and poorer social functioning compared to adults without childhood histories of CAP (Campo et al., 2001; Hotopf et al., 1998; Walker, Garber, Van Slyke & Greene, 1995). The extent to which the relation between pediatric CAP and adult functioning is moderated by children's functional impairment during pain episodes has not been examined. However, the North American Society for Pediatric Gastroenterology, Hepatology and Nutrition Committee on Chronic Abdominal Pain has recently recommended that "return to normal function" be prioritized as a treatment goal (Di Lorenzo et al., 2005a), suggesting the utility of identifying factors that contribute to children's functional impairment.

Relatively few studies have addressed the predictors of children's functional disability (Gauntlett-Gilbert & Eccleston, 2007). While pain intensity and the frequency of pain episodes experienced by youth with chronic pain are associated with broad measures of impairment (Gauntlett-Gilbert & Eccleston, 2007; Hunfeld et al., 2001;

Kashikar-Zuck, Goldschneider, Powers, Vaight & Hershey, 2001; Logan & Scharff, 2005; Merlijn et al., 2006; Peterson & Palermo, 2004), some studies have concluded that pain intensity fails to predict concrete indicators of functioning, such as school attendance (Dunn-Geier, McGrath, Rourke, Latter & D'Astous, 1986; Gauntlett-Gilbert & Eccleston, 2007; Kashikar-Zuck et al., 2001). It has been proposed that children's adaptation to pain is influenced by their interactions with parents and, in particular, by parents' responses to children's pain complaints (e.g., Chambers, 2003; Palermo & Chambers, 2005). Because it is unlikely that most children make decisions about missing school or limiting activities independently, the possibility that parent-child interactions during children's pain episodes influence children's adaptive functioning warrants investigation.

Parent-Child Interaction and Chronic Pain

Parents are the primary socialization agents for most children (Maccoby, 1992). Operant perspectives on chronic pain (see Flor, Birbaumer & Turk, 1990) suggest that parents' responses to children's pain episodes may shape children's own responses to pain. To the extent that parents' responses socialize children's responses to current and future pain, parent-child interaction may influence the degree to which children's normative development is disrupted by pain. Understanding the impact of parent-child interaction on children's adaptation to CAP has become an important aim in the literature (Campo, 2007). The current study summarizes three sources of evidence in support of the proposal that parent-child interaction influences children's adaptation to pain. First, the current study reviews evidence suggesting that parent-child interaction impacts children's

distress and expressions of pain during painful procedures and pain-induction tasks. Second, the current study summarizes accumulating evidence for a relation between parent-child interaction and children's functional impairment in response to pain. Finally, the current study describes evidence of the effectiveness of chronic pain interventions that target parent-child interaction during painful experiences. Evidence for the impact of parent-child interaction on children's adaptation to pain provides a strong foundation for the current investigation of cognitive factors underlying parents' behaviors in response to children's pain.

Parent-Child Interaction, Children's Distress and Reports of Pain

Much of the evidence that parent-child interaction shapes children's responses to pain has arisen from studies of children undergoing painful medical procedures or pain-induction tasks. The relative frequency of painful medical procedures (ranging from routine immunizations to treatment-related procedures), the accessibility of parent-child dyads undergoing such procedures in medical or research settings, and the availability of safe methods for inducing mild pain or discomfort in the laboratory have facilitated the growth of a large body of literature. Findings suggest a consistent relation between parents' behavior and their children's responses to pain in these contexts. Specifically, parent behaviors such as providing distraction, directing children to use specific coping strategies, and using humor have been associated with reductions in children's distress during painful procedures (e.g., Blount, Sturges & Powers, 1990). In contrast, parents' reassuring or solicitous behaviors are consistently related to higher levels of child distress during painful medical procedures (see McMurtry, McGrath & Chambers, 2006) and

greater levels of reported pain during a cold-pressor task (Chambers, Craig & Bennett, 2002). The latter findings are particularly salient because reassuring or solicitous responses to children's pain are relatively common. In fact, observational studies have found parents to make reassuring or solicitous statements during 10% of interactions with children receiving routine immunizations and 28% of interactions with children undergoing lumbar punctures (Blount et al., 1989; Cohen, Manimala & Blount, 2000). To date, little empirical attention has been paid to parents' intentions when responding to children's pain. However, it is likely that parents engage in reassuring behavior with the intention of calming or comforting their children during painful medical procedures or tasks that induce acute pain.

While there is consistent evidence for the impact of parents' behavior during painful medical procedures, less is known about parent-child interaction in the context of chronic pain. In particular, the unpredictable timing and duration of pain episodes associated with chronic pain conditions has presented a challenge to assessing parent and child behavior during these episodes (e.g., Sanders et al., 1989; Sanders, Shepherd, Cleghorn & Woolford, 1994). To date, two studies have attempted to address this challenge by examining the interactions of pediatric chronic pain patients and their parents during pain-induction tasks (Reid, McGrath & Lang, 2005; Walker et al., 2006). While Reid and his colleagues (2005) did not investigate the relation between parents' behavior and children's pain complaints, Walker and her colleagues (2006) found that parental solicitous or reassuring behavior was related to greater symptom reporting among pediatric chronic pain patients. Specifically, CAP patients experiencing experimentally-induced visceral discomfort and whose parents were trained to engage in

solicitous interactions reported more somatic symptoms (including stomachache) than study participants whose parents were trained in distraction or received no instruction (Walker et al., 2006). This is consistent with findings from studies examining parent-child interaction during acute procedural or task-induced pain in suggesting that solicitous parent behavior, compared to distraction, is associated with greater levels of child distress.

Parents of CAP patients may be especially likely to engage in reassuring or solicitous behavior during interactions with their children. For example, in comparison to healthy peers, CAP patients reported that their parents more frequently exhibited solicitous behavior in response to their pain (Walker et al., 1993). It is possible that the nature of CAP patients' symptoms influence the extent to which their parents engage in reassuring behavior: one study found that gastrointestinal symptoms elicited more solicitous behavior than common cold symptoms among parents of school children (Walker & Zeman, 1992). While it is unclear whether parents consciously choose reassuring responses to their children over distracting responses during CAP episodes, there is some evidence that reassuring patterns of parent-child interaction are more acceptable to parents of CAP patients than other patterns. For example, CAP patients' parents who were trained to distract their children while they experienced task-induced discomfort rated distraction as having a potentially negative impact on their children, while CAP patients' parents trained to reassure their children during this task rated attending or reassuring parent behavior as having no potential for negative impact (Walker et al., 2006).

Not only are parents of CAP patients more likely than parents of pain-free children to engage in reassuring behavior during children's pain episodes, but also, the impact of parental reassurance may be especially salient to CAP patients. Walker and her colleagues (2006) compared symptom complaints of CAP patients to those of healthy peers during a laboratory task that induced visceral discomfort. Among participants whose parents were trained to behave solicitously toward their children immediately following induction of visceral discomfort, CAP patients reported significantly more somatic symptoms than pain-free children. This finding was not attributable to differences in parents' behaviors, as parents of CAP patients and parents of pain-free children did not differ in the degree to which their interactions with their children included solicitous statements consistent with their training condition. While replication is necessary, this preliminary finding suggests that the impact of parent-child interaction on children's experiences of physical discomfort, including pain, is particularly important among CAP patients.

In summary, empirical findings consistently show that solicitous parental responding contributes to children's pain and distress during acute painful experiences associated with medical procedures and tasks designed to induce discomfort (Blount et al., 1989; Blount et al., 1990; Chambers et al., 2002; Cohen et al., 2000; McMurtry et al., 2006). While no existing studies have examined parent-child interaction during CAP episodes, a study of parent-child interaction during induced visceral discomfort concluded that solicitous behavior, compared to distracting behavior, was related to greater symptom reporting among CAP patients (Walker et al., 2006). Furthermore, evidence suggests that parents of CAP patients may be especially likely to engage in

reassuring or solicitous behavior during children's pain episodes (Walker et al., 1993) and that solicitous parent-child interaction may be especially salient for CAP patients (Walker et al., 2006). At this point, little is known about the cognitive factors underlying parents' responses to children's pain. The existing evidence suggests that further investigating factors contributing to parental reassurance or solicitousness in response to children's pain is warranted.

Parent-Child Interaction and Children's Functional Impairment

In the context of acute pediatric pain, the relation of parent-child interaction to children's ability to cope during painful medical procedures is well established. In this context, effective coping with pain can be considered reflective of an *absence* of functional impairment. Numerous studies have demonstrated that parents' efforts to distract or encourage coping behaviors are related to subsequent coping behaviors exhibited by children (e.g., distracting conversation or deep breathing) (Blount et al., 1989; Blount et al., 1990; Blount, Landolf-Fritsche, Powers & Sturges, 1991; Frank, Blount, Smith, Manimala & Martin, 1995; Manne, Redd, Jacobsen, Gorfinkle & Schorr, 1990). The importance of parent-child interaction in contributing to children's coping with medical procedures is highlighted by findings that children are better able to tolerate acute pain when parents or other adults act as "coaches" in the use of a coping strategy (e.g., guided imagery) than when children are asked to engage in the same strategy independently (e.g., Fanurik, Zeltzer, Roberts & Blount, 1993). The consistent evidence that particular patterns of parent-child interaction influence children's ability to cope with

painful medical procedures supports a relation between parents' behaviors and children's functioning in the context of acute pain.

In the context of chronic pediatric pain, less is known about the relation between parent-child interaction and children's functional impairment. An early investigation found that parents of adolescent chronic pain patients who frequently missed school due to pain episodes were observed to make significantly more solicitous statements during a physical exertion task (i.e., "Don't overdo it, you won't be able to walk later") than parents of patients with fewer school absences (Dunn-Geier, et al. 1986). Similarly, Walker and Zeman (1992) reported that children's school absences due to abdominal pain were significantly positively correlated with parents' and children's reports of parental reinforcement of illness behavior (e.g., allowing the child special privileges or relief from responsibilities during pain episodes). Although these findings support a direct relation between parent-child interaction and children's functional impairment, the direction of influence is unclear. Stronger evidence that parent-child interaction influences children's functional impairment arises from a recent study examining parents' behaviors during children's completion of a physical exertion task (Reid, McGrath & Lang, 2005). Following parental discouragement of continued effort or sympathy about task-related pain, pediatric chronic pain patients were observed to be less compliant with instructions for completing the physical tasks (Reid et al., 2005). This finding suggests a direct relation between parents' solicitous behavior and children's ability to complete the study tasks. However, Reid and his colleagues also reported that, when children exhibited pain behavior, neither parental discouragement nor encouragement was statistically significantly related to children's subsequent ability to complete the task. This finding

suggests that the link between parent-child interaction and children's functional impairment may be indirect, or may be conditional upon other contextual factors. Other recent studies have supported the importance of considering factors that may moderate the relation between parent-child interaction and children's functional impairment. For example, recent studies have reported that the influence of parental solicitous behavior on patients' functional impairment varies according to patients' levels of anxiety and depression (Peterson & Palermo, 2004), autonomy (Palermo, Putnam, Armstrong & Daily, 2007), and family functioning (Palermo et al., 2007). Further investigation of the relation between parent-child interaction and functional impairment in the context of pediatric chronic pain is clearly warranted.

In summary, empirical findings suggest a direct relation between parent-child interaction and children's ability to cope with acute pain in the context of medical procedures (Blount et al., 1989; Blount et al., 1990; Blount, et al., 1991; Frank et al., 1995; Manne et al., 1990). There have been relatively few studies of the link between parents' behavior and children's functional impairment in the context of chronic pain; however, findings seem to suggest that this relation is moderated by characteristics of the child or parent. It has been proposed elsewhere that the relation between parent-child interaction and children's functional impairment in response to chronic pain is sufficiently complex to demand consideration of the impact of other characteristics of the child, parent, and family (see Palermo & Chambers, 2005). There is a clear need to further investigate the extent to which child, parent, and family characteristics impact the relation of parents' behavior to pediatric pain patients' functional impairment.

Interventions Targeting Parent-Child Interaction in Pediatric Pain

Understanding the impact of parent-child interaction on children's pain, distress, and functional impairment is especially important to the development and implementation of effective family interventions for pediatric chronic pain. To date, family interventions developed to address acute and chronic pediatric pain have been linked to positive outcomes for children and adolescents. In the acute pain setting, behavioral interventions designed to train parents to distract their children before and during painful medical procedures have been effective in reducing children's distress and expressions of pain during these procedures (Blount et al., 1992; Cohen, Blount & Panopoulos, 1997; Cohen et al., 2006; Manimala, Blount & Cohen, 2000; Manne et al., 1990; Powers, 1999). In the context of chronic pain, relaxation and cognitive behavior therapy have been identified as effective interventions for pediatric chronic pain patients (Eccleston, Morley, Williams, Yorke & Mastroyannopooulou, 2002). Recently, the effectiveness of interventions specifically developed to address pediatric CAP has been examined.

To date, six published studies have examined the efficacy of interventions developed specifically for use with CAP patients and their families. Results of these studies suggest that cognitive-behavioral interventions for patients and families are effective in reducing children's pain complaints and illness behavior (Levy & Walker, 2005). Specifically, CAP patients treated with multi-component, behavioral or cognitive-behavioral family interventions have reported lower levels of pain, post-treatment, than patients receiving fiber treatment (Humphreys & Gevirtz, 2000), standard medical care (Duarte et al., 2006), on a wait-list for treatment (Sanders et al., 1989), or receiving no

treatment (Finney, Lemanek, Cataldo, Katz & Fuqua, 1989), and reductions in pain complaints have been maintained for at least six months (Sanders et al., 1994; Robins, Smith, Glutting & Bishop, 2005). Furthermore, multi-component family interventions have been effective in improving children's functional outcomes. CAP patients receiving cognitive-behavioral family intervention have exhibited significantly less functional disability up to one year post-treatment, compared to patients receiving standard medical care (Sanders et al., 1994). Additionally, CAP patients receiving multi-component family interventions report fewer school absences following treatment compared to patients receiving fiber treatment (Humphreys & Gevirtz, 2000), standard medical care (Robins, Smith, et al., 2005) and those who remained untreated (Finney et al.,1989), and also exhibit lower levels of health care utilization (Finney et al., 1989; Humphreys & Gevirtz, 2000).

While the available studies suggest that multi-component family interventions for pediatric CAP often are effective in reducing pain and functional impairment, it is notable that, across studies, a number of indicators suggest that treatment gains were not experienced by all CAP patients. In these studies, between 24 and 28 percent of CAP patients continued to experience abdominal pain immediately following intervention (Humphreys & Gevirtz, 2000; Sanders et al., 1989; Sanders et al., 1994). Nineteen percent of patients rated pain as unchanged or worse (Finney et al., 1989), and patients continued to report an average of two pain "crises" per month, following treatment (Duarte et al., 2006). Six months after intervention, between 12 and 33 percent of CAP patients reported abdominal pain (Sanders et al., 1989; Sanders et al., 1994). Additionally, cognitive-behavioral family intervention, compared to standard medical

care, did not impact children's somatic symptoms (Robins, Smith, et al., 2005). Further refinement of treatment protocols may improve outcomes experienced by CAP patients and their families.

While the specific intervention protocols employed in these six studies varied, all of the interventions included a parent training component in which parents were instructed to minimize discussion of children's pain complaints and encourage activities incompatible with pain behavior rather than respond solicitously to children's pain complaints. The independent effects of intervention techniques targeting CAP patients' behaviors versus parents' behaviors have not been evaluated. However, a single study has attempted to identify the extent to which child and parent behaviors contribute to CAP patients' post-intervention reports of pain and pain behavior. Sanders and his colleagues (1994) reported that, after controlling for pre-treatment pain, more than a quarter of the variance in CAP patients' post-treatment pain was predicted by parents' behavior, including ignoring the pain complaint, acknowledging the pain complaint and then distracting, and prompting independence. Additionally, these parent behaviors in combination with expressing sympathy, seeking medical advice, and exhibiting anger or annoyance with their children explained nearly a quarter of the variance in children's post-treatment pain behavior. These findings suggest that interventions targeting parent-child interaction during children's pain episodes can have a positive impact on children's pain and functional impairment.

In summary, CAP patients treated with multi-component, cognitive-behavioral family interventions achieve positive outcomes including reductions in pain complaints and gains in school attendance and general functioning. Further refinement of treatment

protocols is recommended by the evidence that these interventions are effective for some, but not all, treated CAP patients. There is some evidence to suggest that, following multi-component family intervention, targeted parent behaviors meaningfully predict children's responses to pain. It is anticipated that additional studies will further document the effectiveness of intervention components that specifically target parent-child interaction. Meanwhile, accumulating evidence for a meaningful association between parent-child interaction and children's distress and functional impairment in response to chronic pain warrants continuing examination of factors contributing to parent-child interaction in the context of CAP. In particular, the current study will examine cognitive factors underlying parents' behaviors in response to children's pain. This investigation will be informed by integrating an information-processing perspective on human behavior (see Bijttebier, Vasey & Braet, 2003) with a cognitive-affective model of adaptation to chronic pain (Eccleston & Crombez, 1999).

Implications of Information-Processing Models and the Cognitive-Affective Model of Chronic Pain for Parents' Responses to Children's Pain

Information-processing models are among the most frequently employed frameworks for generating and testing hypotheses about the origins of human behavior. These models posit that individuals understand and manipulate information through a series of cognitive processes, each of which builds upon the output of the previous process. A fundamental characteristic of information-processing models is the limited capacity of the information-processing system (Bijttebier et al., 2003). The notion of limited capacity suggests competition for processing resources, which implies that allocating processing resources is an important task of the information-processing

system. The mechanism by which processing resources are allocated to one signal over another is described as selective attention (Driver, 2001), and the propensity to selectively attend to certain types of signals over others represents an attentional bias. Questions of how and why specific stimuli are selected for further processing are addressed by evolving theories of attention, a complete review of which is beyond the scope of this paper. Eccleston and Crombez, in presenting their cognitive-affective model of chronic pain (1999), provide a coherent summary of the models of attention that have had the broadest influence on studies of attention and pain.

According to a cognitive-affective model of chronic pain (Eccleston & Crombez, 1999), pain is a signal that warrants selective attention due to its implicit threat value. In fact, pain is proposed to be distinctive in the extent to which it demands attention, such that other sources of information will receive less priority for information-processing resources when pain signals are present. Eccleston and Crombez further suggest that prioritizing pain cues allows individuals to perform actions facilitating escape from pain, thereby promoting survival. Based in part on this model, it has been proposed that chronic pain patients may exhibit attentional bias toward pain-relevant signals (see Pincus & Morley, 2001).

Synthesis of an information-processing framework with a cognitive-affective model of chronic pain suggests that understanding parents' attention to pain signals will inform our understanding of parents' responses to their children's pain episodes. Specifically, information-processing paradigms suggest that, at any given time, external environmental stimuli, children's overt behaviors, and parents' own internal processes (e.g., thoughts and feelings) compete for parents' limited attention. The cognitive-

affective model of chronic pain suggests that pain signals will demand greater attention than competing, non-pain signals. The cognitive-affective model of chronic pain also suggests that perception of pain signals motivates behavior believed to facilitate escape from pain. Thus, if parents exhibit attentional bias toward pain-related signals from their children, they may be more likely to interact with their children in ways that they believe will promote pain alleviation.

Attentional Bias to Threat

The extent to which specific signals capture attention has been the subject of numerous investigations, arising from growing interest in the contribution of cognitive processing biases to various affective disorders (see Bar-Haim, Lamy, Pergamin, Bakermans-Kranenburg & van IJzendoorn, 2007; Mogg & Bradley, 2005 for recent reviews). Studies of biased attentional processing have used various methodologies, including the modified Stroop task and the dot probe task, and have examined attention to stimuli presented either consciously or unconsciously. Additionally, recent research has differentiated attentional bias due to vigilance from attentional bias due to difficulty disengaging from threatening stimuli. These methodological issues are briefly summarized in order to establish a foundation for the subsequent review of attentional bias among individuals with chronic pain, CAP, and functional gastrointestinal disorders characterized by abdominal pain.

Assessing Attentional Bias

The modified Stroop task was one of the earliest methods used to examine

attentional bias among individuals with affective disorders (Mathews & MacLeod, 1985). The modified Stroop task assesses attentional processing by presenting patients with emotionally salient or threatening words and neutral words printed in differently colored ink. The task requires patients to name the ink color as each word is presented, and response latencies are recorded for analysis. Slower color-naming is attributed to attentional interference resulting from preoccupation with the salience of the threatening word (Pincus & Morley, 2001; Roelofs, Peters, Zeegers & Vlaeyen, 2002). Thus, slower color naming in response to threat words than in response to neutral words indicates selective attention for threatening stimuli. The validity of the modified Stroop task as a measure of attentional processing has been called into question. Specifically, it has been noted that longer response times may reflect delayed verbal output due to negative affect stimulated by threatening stimuli rather than delayed processing of threatening stimuli (see MacLeod, Mathews & Tata 1986).

The dot probe task (MacLeod et al., 1986) was developed as an improved measure of selective attention. Whereas the modified Stroop task required a neutral response (color naming) to a salient stimulus (emotionally threatening word), the dot probe task requires a neutral response (button press) to a neutral stimulus (dot probe) (MacLeod et al., 1986). During a classic dot probe task, individuals are presented with pairs of threat-related and neutral words or pictures on a computer screen, with the threatening stimulus appearing in either an upper or lower position in relation to the neutral stimulus. One stimulus per pair is followed by a dot "probe", and patients are asked to press a button on the keyboard to identify the position in which the probe appeared (i.e., upper or lower). Faster response times are interpreted as representing

selective attention to the stimulus (threatening or neutral) presented in the probed position. Speeded responses to probed threat stimuli have been interpreted as evidence of selective attention toward threatening information, while faster responses to probed neutral stimuli have been interpreted as avoidance of threat (Boyer et al., 2006). The dot probe task has been employed by researchers examining attentional biases among patients with various clinical presentations, including depression (e.g., Donaldson, Lam & Mathews, 2007); generalized anxiety disorder (e.g., Bradley, Mogg, White, Groom & deBono, 1999); social anxiety (e.g., Pineles & Mineka, 2005); post-traumatic stress disorder (e.g., Elsesser, Sartory & Tackenberg, 2004); and chronic pain (see Pincus & Morley, 2001; Roelofs et al., 2002).

Conscious versus Pre-Conscious Processes

It is widely accepted that human attention is not a single construct, but rather a set of interrelated processes that contribute to "selectivity in mental life" (see Driver, 2001). While numerous theories of selective attention have been proposed and revised, a seminal distinction between controlled and automatic processing (Schneider & Shiffrin, 1977; Shiffrin & Schneider, 1977) remains relevant. Controlled attentional processes are strategic and available to conscious awareness, while automatic attentional processes occur outside of conscious awareness (Shiffrin & Schneider, 1977). While early accounts held that automatic processing resulted from consistently over-learned efforts of the strategic attentional system (Schneider & Shiffrin, 1977), others have proposed that specific automatic attentional processes (e.g., those that detect pain) are biologically "hard-wired" (see Eccleston & Crombez, 1999). It has been suggested that automatic,

pre-conscious processing mechanisms with the ability to detect threats to survival are particularly adaptive (Robinson, 1998). Several studies of attentional bias have attempted to assess attention to both conscious and preconscious attentional mechanisms (e.g., Afzal, Potokar, Probert & Munafò, 2006; Boyer et al., 2006; Lipani, 2007; MacLeod & Rutherford, 1992)

In computerized Stroop and dot probe tasks, conscious attentional processes are assessed by the use of supraliminal presentation conditions, in which the presentation duration is long enough for stimuli to enter conscious awareness. Some studies have attempted to ensure that stimuli enter conscious awareness by asking participants to read word stimuli as they appear (e.g., Asmundson & Hadjistavropoulos, 2007). Pre-conscious processes are assessed by subliminal presentation conditions, during which stimuli are presented briefly (e.g., 20 milliseconds) and immediately replaced by non-meaningful "masks". Validity tests assessing whether masked stimuli enter conscious awareness have illustrated that subliminal exposure conditions are effective in preventing stimuli from being consciously processed (Afzal et al., 2006; Boyer et al., 2006; MacLeod & Rutherford, 1992).

Vigilance versus Difficult Disengagement

Selective attention to threat can be further described in terms of vigilance and disengagement, such that attentional vigilance is a state of alertness to certain signals and attentional disengagement is the ability to shift attention away from a signal that was previously attended to (Koster, Crombez, Verscheure & De Houwer, 2004). Early studies employing the Stroop and dot probe task often concluded that evidence of attentional bias

represented hypervigilance for threat. However, recent work suggests that this interpretation neglects the possibility that attentional bias is due to difficulty disengaging from threatening stimuli (Fox, Russo, Bowles & Dutton, 2001; Koster et al., 2004). Distinguishing vigilance toward threatening stimuli and difficulty disengaging from threatening stimuli requires consideration of what Koster and his colleagues refer to as "congruency effects" (Koster et al., 2004).

In the context of the dot probe paradigm, a congruency effect is exhibited when individuals respond more quickly to probes replacing threat words (congruent probes) than to probes replacing neutral words (incongruent probes) in threat-neutral word pairs (Koster et al., 2004). As noted by Koster and his colleagues, individuals may respond more quickly to congruent probes than incongruent probes because their attention is more easily captured by threatening versus neutral stimuli (indicating vigilance) or because they have difficulty shifting attention away from threatening stimuli (indicating difficult disengagement). To address the confounded nature of attentional patterns of vigilance and disengagement in past research employing Stroop and dot probe paradigms, Fox and her colleagues (2001) modified an exogenous cueing paradigm (Posner, Inhoff, Friedrich & Cohen, 1987) that has subsequently been adopted by other research groups (e.g., Van Damme, Crombez & Eccleston, 2004). However, Koster and his colleagues (2004) proposed that vigilance and disengagement can be distinguished using the dot probe task when the paradigm includes neutral-neutral word pairs in addition to threat-neutral word pairs. Indeed, their preliminary investigation of vigilance and disengagement to threatening word stimuli suggested that the significance of the congruency effect was attributable to difficulty disengaging from threatening stimuli, rather than enhanced

vigilance (Koster et al., 2004). Subsequently, several investigations have attempted to distinguish vigilance effects from disengagement effects (Asmundson, Carleton & Ekong, 2005; Asmundson & Hadjistavropoulos, 2007; Asmundson, Wright & Hadjistavropoulos, 2005; Koster, Crombez, Verscheure & de Houwer, 2006; Koster, Verscheure, Crombez & Van Damme, 2005; Roelofs, Peters, Fassaert & Vlaeyen, 2005; Salemink, van den Hout & Kindt, 2007). As a supplement to widely used measures of attentional bias, indices of attentional vigilance and disengagement allow for more in-depth analysis of attentional processes assessed by the dot probe (Asmundson, Carleton, et al., 2005).

Evidence of Attentional Bias toward Pain-relevant Stimuli

The interruptive function of pain is well established in the empirical literature (see Eccleston & Crombez, 1999) and is foundational to the cognitive-affective account of chronic pain. Numerous studies have aimed to clarify the interruptive effects of pain by determining the extent to which pain-relevant stimuli elicit attentional bias in both healthy individuals and those with chronic pain. In order to further inform the current investigation of attentional biases among parents of CAP patients and parents of pain-free children, this paper will briefly review evidence for attentional bias to pain-relevant stimuli among healthy adults and adult chronic pain patients. The literatures examining attentional bias toward pain-relevant stimuli in healthy adults and in chronic pain patients are equally relevant to the current study. While attentional patterns exhibited by parents of pain-free children are expected to be similar to those of healthy adults, attentional

patterns exhibited by parents of CAP patients may be more similar to patterns exhibited by chronic pain patients.

Not only do pediatric CAP patients have more relatives with histories of abdominal pain or diagnosed abdominal disorders than well children (Walker, Garber & Greene, 1993; Wasserman, Whitington & Rivara, 1988), but also, mothers of CAP patients more often report somatic symptoms (Walker & Greene, 1989) and have lifetime histories of IBS, migraine, chronic fatigue syndrome and somatoform disorders (Campo et al., 2007) than mothers of pain-free children. Subsequently, while parents of CAP patients were not selected for participation in the current study based on their own experiences with pain, it is possible that some will exhibit attentional bias to pain-relevant stimuli influenced by salient personal pain histories. Following the summary of evidence for attentional bias toward pain-relevant stimuli among healthy adults and among chronic pain patients, this section ends with a summary of evidence for attentional bias toward pain-relevant stimuli among patients with abdominal pain. Because the literature concerning attentional bias among patients with abdominal pain is relatively small, this summary includes studies of pediatric and adult patients with abdominal pain.

Attentional Bias to Pain in Healthy Adults

Consistent with Eccleston and Crombez's proposal (1999) that pain is universally threatening, several studies have found evidence of attentional bias to pain-relevant stimuli among healthy individuals. For example, healthy adults have been shown to exhibit attentional interference (i.e., slowed color naming on the Stroop task) in response to pain-relevant and IBS-relevant words (one third of which were pain-relevant)

compared to neutral words (Afzal et al., 2006; Roelofs, Peters & Vlaeyen, 2002). Additionally, subgroups of healthy adults characterized by varying degrees of pain-related fear and different appraisals of a pain-inducing task exhibited distinct patterns of attentional bias toward pain-relevant stimuli presented during dot probe tasks (Boston & Sharpe, 2005; Keogh, Ellery, Hunt & Hannent 2001; Keogh, Thompson & Hannent, 2003). In all, five studies provide evidence that healthy individuals exhibit attentional bias to pain-relevant stimuli presented to conscious awareness, supporting the proposal that pain is universally threatening.

However, this evidence is not unequivocal: several studies have concluded that healthy individuals do not exhibit attentional bias to sensory pain or affective pain words (Andersson & Haldrup, 2003; Asmundson, Carleton, et al., 2005; Asmundson & Hadjistavropoulos, 2007; Asmundson, Kuperos & Norton, 1997; Pearce & Morley, 1989). Moreover, one study reported that healthy individuals completing a modified Stroop task actually responded more quickly to subliminally presented sensory pain words than to neutral words, which contradicts expected findings of attentional interference (Asmundson, Wright, et al., 2005). These divergent results suggest that empirical findings of attentional bias to pain among healthy individuals are inconclusive, and warrant further attention.

Attentional Bias to Pain in Adult Chronic Pain Patients

Studies of attentional bias to pain-relevant stimuli among chronic pain patients also have produced mixed findings. Some of the research examining attentional bias among chronic pain patients has yielded evidence in support of a cognitive-affective

model of chronic pain (Eccleston & Crombez, 1999). Specifically, several studies employing modified Stroop or dot probe tasks have concluded that chronic pain patients exhibit attentional bias toward pain-related stimuli (words or pictures), compared to neutral stimuli (Andersson & Haldrup, 2003; Crombez, Hermans & Adriaensen, 2000; Pearce & Morley, 1989; Snider, Asmundson & Weise, 2000). Sensory pain words, in particular, may have salient effects on pain patients' attention (Dehghani, Sharpe & Nicholas, 2003, 2004). Furthermore, some studies have reported that chronic pain patients exhibit significantly greater attentional bias toward pain-relevant stimuli than healthy individuals. A recent meta-analysis of five published studies using the Stroop methodology concluded that chronic pain patients consistently exhibit greater attentional bias toward sensory and affective pain words than healthy participants (Roelofs, Peters, Zeegers, et al., 2002). Findings from dot probe studies also have supported this conclusion, specifically reporting that chronic pain patients exhibit a greater degree of difficulty disengaging from pain-relevant stimuli than healthy individuals (Asmundson, Wright, et al., 2005; Roelofs et al., 2005). In summary, several studies have reported evidence consistent with the cognitive-affective model of chronic pain (Eccleston & Crombez, 1999).

However, evidence for attentional bias toward pain-relevant stimuli among chronic pain patients has been mixed with contrasting findings. For example, several studies have reported no evidence of selective attention to pain-related versus neutral stimuli among pain patients (Asmundson, Carleton, et al., 2005; Asmundson & Hadjistavropoulos, 2007; Pincus, Fraser & Pearce, 1998), and others have suggested that attentional bias is evident only among subgroups of pain patients (Crombez et al., 2000),

such as those with low fear of pain (Asmundson et al., 1997). Moreover, several studies have concluded that chronic pain patients do not differ from healthy volunteers in their attentional responses to pain-relevant and neutral stimuli (Andersson & Haldrup 2003; Asmundson, Carleton, et al., 2005; Asmundson & Hadjistavropoulos, 2007; Asmundson, Wright, et al., 2005). In summary, although several studies have supported the hypothesis that chronic pain patients exhibit attentional bias toward pain-relevant stimuli, the existence of divergent findings suggests the need for further investigation of attentional processing of pain-relevant stimuli among chronic pain patients.

Attentional Bias to Pain in Patients with Abdominal Pain

While several studies have examined attentional bias to threat among healthy adults and chronic pain patients, only three studies to date have investigated attentional processes in patients with primary complaints of abdominal pain. All three studies suggest that individuals with abdominal pain exhibit attentional bias toward pain-related stimuli, although there is some variability in the parameters under which bias has been observed. In the only study of adult patients, Afzal and his colleagues (2006) found that IBS patients did not differ from healthy controls in their response latencies to symptom-related words. However, IBS patients exhibited slower color-naming when symptom-related words were presented subliminally (i.e., outside of conscious awareness) than when words were presented supraliminally (i.e., within conscious awareness). Afzal and his colleagues suggested that their findings reflect disease-related cognitive processes that impact initial, unconscious orienting toward stimuli.

Two investigations have addressed attentional processes among pediatric CAP patients. Boyer and her colleagues (2006) reported a pattern that partially confirmed what Afzal and his colleagues observed among adult IBS patients: children with CAP exhibited selective attention toward pain-related threat words compared to neutral words when words were presented subliminally. When words were presented supraliminally, children exhibited the opposite pattern, attending to neutral words preferentially over pain-related threat words (Boyer et al., 2006). In contrast to Boyer's findings, Lipani (2007) reported that pediatric CAP patients exhibited attentional bias toward pain-relevant threat words when they were presented supraliminally, but not subliminally. Furthermore, Lipani found that pediatric patients exhibited a greater degree of attentional bias toward pain-related threat words than did pain-free children when words were presented on the level of conscious awareness. In summary, the available evidence suggests that adult and pediatric patients with abdominal pain exhibit complex patterns of biased attention, characterized by attention to pain-relevant stimuli presented to both conscious and preconscious levels of awareness. While further replication is needed, these preliminary results suggest that attentional bias toward pain-related words among patients with abdominal pain may exceed that exhibited by healthy individuals.

Correlation of Attentional Bias with Psychological Characteristics

Equivocal evidence of attentional bias to pain-relevant stimuli may be interpreted to indicate that some, but not all, healthy individuals and chronic pain patients exhibit attentional bias toward pain signals. For example, it is possible that the mixed nature of existing findings among chronic pain patients reflects the existence of subgroups of

patients characterized by different degrees of attentional bias, or by attentional bias toward different types of pain-relevant material (Crombez et al., 2000). Preliminary attempts to clarify the nature of attentional bias effects among pain patients and healthy individuals have suggested that certain physical or psychological characteristics are related to, and may predict, attentional bias toward pain signals. The current investigation will examine how attentional bias is related to two physical characteristics: parents' ratings of bodily pain and general health. As described in previous sections, personal experiences of pain or health may contribute to attention toward pain-relevant signals. The current investigation also will examine how attentional bias is related to two psychological characteristics: anxiety and appraisals. The following section provides a rationale for investigating these psychological factors as correlates of attentional bias among parents of CAP patients and parents of pain-free children.

Attentional Bias and Anxiety

Based on empirical evidence that attentional bias plays an important role in the development and maintenance of anxiety disorders among youth and adults (see Bar-Haim et al., 2007; Puliafico & Kendall, 2006 for recent reviews), numerous investigations have hypothesized that anxiety may be related to attentional bias toward pain-relevant stimuli. Specifically, studies have investigated the associations between individuals' self-reported symptoms of state and trait anxiety, fear of pain, and anxiety sensitivity and their attentional bias toward pain-relevant stimuli. At present, evidence supporting a meaningful association between anxiety and attentional bias toward pain-relevant stimuli is inconclusive.

Evidence for a relation between measures of state or trait anxiety and attentional bias to pain-related material has been particularly inconsistent. A few studies have reported correlations between state or trait anxiety and attentional vigilance, disengagement and avoidance. For example, among healthy adults and chronic pain patients, higher levels of state anxiety have been associated with attentional interference on the Stroop task and both attentional vigilance toward and difficulty disengaging from pain-relevant words on the dot probe task (Asmundson, Carleton, et al., 2005; Pincus et al., 1998). Similarly, among pediatric CAP patients, anxiety symptoms have been related both to avoidance of pain-relevant words and greater attention toward pain-relevant words (Boyer et al., 2006; Lipani, 2007). Finally, among children without chronic pain complaints, elevated symptoms of anxiety have been related to greater bias toward pain-relevant stimuli (Lipani, 2007). However, a larger number of studies have failed to find evidence of a meaningful relation between state or trait anxiety symptoms and attentional patterns among chronic pain patients (Andersson & Haldrup, 2003; Asmundson, Wright, et al., 2005; Crombez et al., 2000; Dehghani et al., 2003) or healthy individuals (Andersson & Haldrup, 2003; Asmundson, Wright, et al., 2005; Keogh et al., 2001; Roelofs, Peters & Vlaeyen, 2002).

Anxiety sensitivity and fear of pain also have been examined in relation to attentional bias to pain-relevant stimuli. Anxiety sensitivity, described as the fear of anxiety-related symptoms based on beliefs about their harmful consequences, is distinct from trait and state anxiety (Reiss, Peterson, Gursky & McNally, 1986). Higher levels of anxiety sensitivity have been associated with a greater degree of attentional bias toward sensory pain words (Asmundson, Carleton, et al., 2005). Fear of pain, which is predicted

by anxiety sensitivity (Asmundson, Kuperos & Norton, 1997), has also been correlated with attentional bias toward pain-relevant stimuli. For example, recent studies have suggested differential effects of high and low levels of fear of pain on attentional bias toward pain among healthy adult volunteers. Specifically, healthy adults with high fear of pain have exhibited attentional bias toward pain-related words in a dot probe task (Keogh et al., 2001; Keogh et al., 2003), while individuals with low fear of pain have exhibited attentional avoidance of pain-relevant words (Asmundson et al., 1997). This evidence supports a complex but coherent relation between anxiety sensitivity or fear of pain and attentional bias toward pain-relevant stimuli. However, several studies have failed to support a statistically significant association between these anxiety-related constructs and attentional biases to pain-relevant stimuli among chronic pain patients (Asmundson, Wright, et al., 2005; Crombez et al., 2000; Dehghani et al., 2003) or healthy individuals (Asmundson, Wright , et al., 2005; Roelofs, Peters & Vlaeyen, 2002; Roelofs, Peters, van der Zijden, Thielen & Vlaeyen, 2003). Nonetheless, the possibility that pain-related fear and related attentional processes exert a negative impact on adjustment to chronic pain remains an interesting question in the chronic pain literature (Vlaeyen & Linton, 2000).

In summary, the existing literature fails to provide consistent evidence that greater attentional bias to pain-relevant stimuli is associated with higher levels of self-reported anxiety among healthy adults and chronic pain patients. Nevertheless, there are compelling reasons to examine whether attention to pain-relevant stimuli exhibited by parents of CAP patients is associated with their own reported anxiety symptoms. First, attentional bias and its correlates have not been examined among parents of pain patients. The studies failing to find significant associations between attentional bias and self-

reported anxiety symptoms have utilized samples of college students (Keogh et al., 2001; Roelofs, Peters & Vlaeyen, 2002) or hospital employees (Asmundson, Wright, et al., 2005), or have failed to specify the population from which their sample was drawn (Andersson & Haldrup, 2003). Parents of school-aged children may have little in common with participants in previous studies. Second, evidence that parents of CAP patients exhibit heightened levels of anxiety suggests that they may exhibit attentional patterns more similar to adults with diagnosed anxiety disorders than to healthy adults. For example, one study reported that nearly half of mothers of CAP patients met lifetime criteria for an anxiety or depressive disorder (Campo et al., 2007), and several investigations have found that parents of children with CAP report more symptoms of anxiety than parents of pain-free children (Hodges, Kline, Barbero & Woodruff, 1985; Walker & Greene, 1989). Individuals with anxiety disorders consistently exhibit attentional bias toward threatening stimuli (Bar-Haim et al. 2007, Mogg & Bradley, 2005); thus, evidence that parents of CAP patients often exhibit heightened anxiety recommends further investigation of the relation between anxiety symptoms and attentional bias in this population.

Attentional Bias and Appraisal

Cognitive appraisals, according to Lazarus and Folkman's transactional model of stress and coping, represent evaluations of a situation's implications for one's well-being (Lazarus & Folkman, 1984; Lazarus, 1993). Primary appraisals refer to perceptions of the situation's influence on the person, whether that influence has already occurred or is anticipated to occur in the future. Secondary appraisals refer to the individual's perceived

ability to handle the demands of the situation, including perceptions of the extent to which some strategy might meet those demands, and the individual's perceived competence to use such a strategy. According to appraisal theory, primary and secondary appraisals interact to influence how individuals perceive and respond to particular situations (Lazarus & Folkman, 1984).

Attention to pain-relevant stimuli may be determined, in part, by the appraised threat value of those stimuli (Van Damme, Crombez & Eccleston, 2002). The empirical literature has not yet addressed possible relations between parents' appraisals and their attention to pain-relevant stimuli. However, preliminary evidence supports the theoretical link between primary appraisals of pain severity and attentional bias toward pain-relevant words. Healthy adults to whom a laboratory activity was described in threatening terms exhibited greater selective attention toward affective pain words presented during a dot probe task that preceded the laboratory activity, compared to adults who received a reassuring explanation of the activity (Boston & Sharpe, 2005). This finding suggests that the appraisal of future pain activates attentional bias toward pain-relevant stimuli. Among parents of CAP patients, whose children experience intermittent, unpredictable pain episodes, it may be the case that the appraisal system is constantly alerted to the possibility of pain. Indeed, parents of adolescents with chronic pain have described their parenting experience as shaped by vigilance and alertness to their children's pain (Jordan, Eccleston & Osborn, 2007). In this context, parents' appraisals of the severity of their children's pain and coping skills may shape the extent to which parents' appraise pain cues as threatening. It is possible that parents' primary appraisals of the impact of pain

for their children and secondary appraisals of their children's competence in coping with pain are related to distinct patterns of attentional bias to pain-relevant stimuli.

The Current Study

Overview

The current study investigates whether parents of pediatric patients with chronic abdominal pain (CAP) and parents of pain-free children exhibit attentional bias toward pain-relevant stimuli (i.e., physical threat words) versus neutral stimuli. In addition, the study investigates whether parents of CAP patients exhibit greater attentional bias toward pain-relevant stimuli than parents of pain-free children. Because this study is the first to examine attentional processes among parents of pediatric patients and pain-free children, the analysis of hypothesized effects is accompanied by exploratory analyses investigating whether parents' patterns of attention to pain-relevant words reflect vigilance to threatening stimuli, difficult disengagement from threatening stimuli, or both. Additional exploratory analyses examine patterns of attention toward pre-conscious (subliminal) and conscious (supraliminal) presentations of pain-relevant stimuli. In addition to examining differences in the patterns of attention exhibited by parents of CAP patients and parents of non-patients, secondary analyses examine the hypothesis that parents reporting symptoms of pain-related FGIDs exhibit greater attentional bias to pain-relevant stimuli than symptom-free parents. Finally, the current study examines specific hypotheses about the relation of attentional bias to parents' ratings of general health and bodily pain, anxiety, and appraisals of children's pain severity and coping ability.

Study Hypotheses

Hypothesis 1: Attentional bias toward pain-relevant versus neutral stimuli. Parents of CAP patients and parents of pain-free children are expected to attend to pain-relevant words to a greater degree than neutral words. Specifically, parents are expected to respond more quickly to probed pain-relevant words than to probed neutral words in dot probe trials presenting paired pain-relevant and neutral words.

Provided evidence of significant attentional bias toward pain-relevant words compared to neutral words, exploratory analyses will examine whether parents' attention to pain-relevant words is best described as vigilance or difficulty disengaging. Distinguishing vigilance and disengagement effects exhibited during the dot probe requires comparison of "experimental" trials (in which a probe replaces either a threat or neutral word in a threat-neutral trial) with "control" trials (in which a probe replaces a neutral word in a neutral-neutral pairing) (Koster et al., 2004; Roelofs et al., 2005). As described by Roelofs and his colleagues (2005), vigilance is indicated when individuals exhibit faster response times to probed threat words in threat-neutral pairs than to probed neutral words in neutral-neutral pairs. Difficult disengagement is indicated when individuals exhibit slower response times to probed neutral words in threat-neutral pairs than to probed neutral words in neutral-neutral pairs. (e.g., Roelofs et al., 2005).

Hypothesis 2: Differences in attentional patterns exhibited by parents of CAP patients and parents of pain-free children. Parents of CAP patients are expected to exhibit a greater degree of attentional bias to pain-related stimuli than parents of pain-free children. Exploratory analyses will examine whether parents of CAP patients and parents

of pain-free children differ in their attention to pain-relevant words presented subliminally versus supraliminally.

Secondary analyses will examine patterns of attention between groups of parents with and without symptoms of abdominal pain-related FGIDs and between parents with frequent abdominal pain and pain-free parents. Across groups of parents of children with CAP and pain-free children, it is expected that parents who report symptoms of IBS or other pain-related FGIDs and parents who report frequent abdominal pain will exhibit greater attentional bias to pain-relevant words than parents with no history of pain-related FGIDs or abdominal pain.

Hypothesis 3: Relation of attentional bias to physical and psychological characteristics. Across groups of parents (i.e., parents of patients and parents of pain-free children), the degree of attentional bias toward pain-relevant words is expected to be negatively correlated with parents' ratings of freedom from bodily pain and general health. That is, greater attentional bias to physical threat words will be associated with elevated reports of bodily pain and poor ratings of general health. Furthermore, the degree of attentional bias toward pain-relevant words is expected to be positively correlated with parents' self-reported symptoms of anxiety.

Hypothesis 4: Relation of attentional bias to parent appraisals of children's pain and coping. Among parents of pain patients, parents' ratings of the severity of children's pain and children's ability to cope with pain are expected to be related to the degree of parents' attentional bias toward pain-relevant stimuli during completion of the dot probe task. Specifically, appraisals of high pain severity and low coping efficacy are expected

to be associated with a greater degree of attentional bias than appraisals of relatively low pain severity and high coping efficacy.

CHAPTER II

METHODS

Participants

Parents of CAP Patients

Parents of CAP patients were participants in a larger study that involved completing questionnaires during their children's initial visits to the Gastroenterology Clinic at Vanderbilt Children's Hospital. Following their participation in the initial study, patients' caregivers were contacted by telephone by a research assistant who conducted a screening interview for the current study. Eligibility criteria required that children were between the ages of 8 and 16 years, had experienced abdominal pain at least three times in the previous three months, were not diagnosed with any chronic illness (e.g., severe asthma, Crohn's disease), and had not undergone surgery in the previous 12 months. Patients who were receiving special education services for reading difficulties were excluded, as were patients with attention deficit/hyperactivity disorder, due to the possibility that these conditions could adversely influence their completion of study tasks. All caregivers of eligible participants were eligible for the study.

Research assistants attempted to contact 252 caregivers of children with CAP for study screening and recruitment. Thirty-eight families were never reached; therefore, 214 caregivers completed the screening interview. Fifty-nine children were determined to be ineligible for the study. Of the 155 eligible families, 76 declined participation, and two

were unable to reschedule appointments changed by project personnel due to equipment failure. Consequently, 77 caregivers of children with CAP (49.7% of contacted caregivers whose children were eligible) participated in the study. Because we did not assess the extent to which non-parent caregivers are involved in the daily lives of participating patients, data from non-parent caregivers were excluded from analyses. This decision resulted in exclusion of a single participant's data. The final sample of 76 parents of CAP patients includes 64 mothers (83%) and 12 fathers (16%)

Parents of Pain-Free Children

Caregivers of pain-free children were identified through a large screening study of public school children in Cheatham County and through an email advertisement circulated to faculty and staff of Vanderbilt University. The screening study and email advertisement were implemented in order to recruit healthy children to participate in research studies; caregivers were eligible for participation if their children met study inclusion criteria. A research assistant contacted children's caregivers to conduct the screening interview. Children were eligible to participate if they were between the ages of 8 and 16 years and, by parent report, had no known chronic illness or chronic pain complaint, had not undergone surgery in the last year, did not experience known reading difficulties and were not diagnosed with ADHD, anxiety or depression. Children who had experienced moderate or severe pain at least once each month for the previous three months were excluded. Children who had experienced mild pain more than once a month also were excluded. Children experiencing mild pain only once per month in the previous three months were considered for participation on a case-by-case basis. Girls who were

reported to experience moderate or severe abdominal pain related to menstruation were excluded from the study; girls who were reported to experience mild abdominal pain associated with menstruation were eligible.

Research assistants attempted to contact 306 caregivers of non-patients, 47 of whom were not recruited for participation because their children were ineligible for the study. Of the 259 eligible families, 86 declined participation and 91 were unavailable for research appointments. In all, 82 pain-free children participated in this study. One caregiver of a pain-free child declined to participate after arriving for the research appointment, and eight participating children were accompanied by non-parent caregivers whose data were excluded from analyses. The final sample of 73 parents of pain-free children includes 61 mothers (84%) and 12 fathers (16%).

Measures

Selective Attention to Pain-Relevant Stimuli

The modified dot probe task used by Lipani (2007) in her study of pediatric CAP patients and pain-free children was employed in this study of her participants' parents. Both pain-relevant threat words (e.g., "painful", "disease") and socially-relevant threat words (e.g., "loser", "lonely") were used in this dot probe paradigm, although the current study did not examine attention socially-relevant threat words. The dot probe task presented 20 pain-relevant threat words and 20 social threat words, each paired with a neutral word (e.g., "when", "across") with the same number of letters. Additionally, two sets of neutral word pairs were generated, with each set consisting of 20 word pairs. The

40 neutral-neutral word pairs also were matched on the number of letters in each word. Children participating in Lipani's study (2007) completed the dot probe twice, with the first round containing one set of neutral-neutral word pairs and the second round containing the alternate neutral set. Parents completed the dot probe task once and thus were exposed to all of the pain-relevant threat-neutral word pairs and half (i.e., twenty) of the neutral-neutral word pairs.

Words were selected for inclusion in this dot probe study based on ratings of their readability, threat value and category affiliation. First, threat and neutral words were carefully selected to ensure that participants could reasonably be expected to read and comprehend them: only words that were judged by both a third grade and a fourth grade teacher to be readable by students completing the third grade were used. Second, the threat value of all selected words was rated by schoolchildren between the ages of 8 and 15 years who were participating in a larger survey study. Children completed rating forms on which they indicated whether each presented word was "very bad," "bad," "a little bad," "not good and not bad," "a little good," "good," or "very good." A rating of "very bad" was assigned a value of -3, whereas a rating of "very good" was assigned a rating of +3. At least 24 children rated each word, and mean rating scores were calculated. Selected threat words had average ratings between –1.5 and -3 (i.e., between "a little bad" and "very bad"), while selected neutral words had average ratings between –1 and 1 (i.e., average rating between "a little bad" and "a little good"). This word rating procedure was similar to that employed in previous studies (e.g., MacLeod, Rutherford, Campbell, Ebsworthy & Holker, 2002). Third, based on procedures used by Vasey and his colleagues (Vasey, El-Hag & Daleiden, 1996), the validity of assigning words to the

categories, "physical threat," "social threat," and "neutral" was assessed by asking graduate students naïve to the nature of the dot probe task to rate each word as “positive”, “social threat”, “physical threat” or “does not fit any of these categories.” The categories “positive” and “does not fit any of these categories” were included to ensure that none of the “neutral” words selected for this study had positive associations. If four out of five graduate students who rated each word agreed on that word's categorization (80% agreement) as “social threat”, “physical threat” or “does not fit any of these categories” (i.e., “neutral), the word was considered for inclusion. The final word list was agreed upon by the research team. Table 1 presents the threat-neutral and neutral-neutral word pairs used in the dot probe task.

Table 1

Pain-relevant Threat and Neutral Word Pairs Used in the Dot Probe Task

Pain-relevant threat/Neutral	*Neutral/Neutral*	
flu/lid	can/rug	and/mop
ill/cup	comb/rack	flow/tent
stab/iron	book/gate	long/lock
sick/lamp	name/door	tree/bowl
pain/coat	lens/fork	yard/page
hurt/then	tail/dive	tile/seat
burn/when	knees/there	enter/frame
ache/clap	thing/curve	paper/chair
germs/hills	label/watch	where/world
cramp/broom	shelf/dryer	steps/chalk
bleed/about	drain/clock	stack/spray
injure/button	brush/plate	decade/branch
disease/streets	zipper/napkin	ladder/bucket
painful/address	rattler/number	garden/button
throwup/balloon	morning/weather	window/around
headache/backpack	shoulder/question	pencil/folder
accident/umbrella	fountain/sentence	suitcase/sidewalk
emergency/paperclip	driveway/doorbell	placemat/trashcan
bellyache/newspaper	calendar/neighbor	upstairs/doorknob
stomachache/streetlight	rectangle/container	microwave/buildings

The dot probe task was presented on a 15-inch computer monitor. Timing and order of word-pair presentation were controlled using E-Prime software (Psychology Software Tools, 2001). During the dot probe task, each parent was exposed to 20 word pairs containing one pain-relevant threat word and one neutral word (threat-neutral pairs), 20 word pairs containing one socially-relevant threat word and one neutral word, and 20 word pairs containing two neutral words (neutral-neutral pairs). Trials were counter-balanced for supraliminal versus subliminal exposure, so that each participating parent was exposed to all 60 word pairs in both supraliminal and subliminal conditions, yielding a total of 120 dot probe trials. The order in which the word pairs were presented and the sequence of subliminal and supraliminal trials were randomly determined by the computer program for each new participant.

Each presentation trial was preceded by the appearance of an addition sign ("+") in the middle of the screen for 1 second (1000 milliseconds). Parents were instructed to focus their attention on this symbol each time it appeared. When the addition sign disappeared, a word pair was presented with one word above and one word below the position in which the addition sign appeared. The upper and lower word positions were equidistant from the position of the addition sign and the position (i.e., upper or lower) of threat words in threat-neutral word pairs was counterbalanced within subjects. In the supraliminal condition, word pairs were presented for 1250 milliseconds (following Vasey, 1996). In the subliminal condition, word pairs were presented for 20 milliseconds before being replaced with non-meaningful letter strings (e.g., NCEPFR), which remained on the screen for 1230 milliseconds (following Boyer et al., 2006), ensuring that each trial was of the same length, regardless of word presentation condition. Previous

studies in which subliminal trials were presented for 20 milliseconds have reported that words were not readable to participants at this brief exposure duration (Boyer et al., 2006; Lipani, 2007; Luecken, Tartaro & Appelhans, 2004). Non-meaningful letter strings had the same number of letters as the words they replaced.

Following every trial, a probe (".") appeared in the same position as either the upper or lower word had previously appeared. Probe position also was counterbalanced within subjects, to ensure that parents were exposed to trials in which threat words were probed in both the upper and lower positions. Parents were instructed to indicate the probe's location as quickly as possible, by pressing either the "c" or "m" key on a standard keyboard. The assignment of "c" and "m" to represent "upper" and "lower" probes was randomized: for approximately half of the participants, "c" indicated that the probe was in the upper position; for the other participants, "m" indicated that the probe was in the upper position. The "c" and "m" keys were affixed with labels indicating the response assigned to each key, and small "up" and "down" cards were attached to the bottom of the computer monitor in positions corresponding with the "c" and "m" keys. The computer recorded response latencies, which were used to calculate attentional bias scores.

A lexical decision task was used to assess the validity of the subliminal exposure condition, that is, whether participants were able to consciously read words presented for 20 milliseconds. Similar tasks have been utilized in other studies employing a dot probe paradigm (e.g., Boyer et al., 2006). During the lexical decision task, participants were informed that, after an initial 1-second presentation of the addition sign ("+"), two words would briefly appear on the monitor before being replaced by non-meaningful strings of

letters (masks). They were informed that the words were either real words (e.g., “house”, “driveway”) or "nonsense" words (e.g., “blorky”, “snidbell”). The real and nonsense words were presented for 20 milliseconds before being replaced by the masks, which had the same number of letters as the real and nonsense words being masked. The masks remained on the screen for 1230 milliseconds, after which time a question mark ("?") appeared, signaling the participant to respond "yes" if the word was a real word and "no" if the word was a nonsense word. As before, participants used the "c" and "m" keys to respond, the assignment of "yes" and "no" to each of those keys was randomized, and the keys and monitor were marked to indicate which key corresponded to "yes" and "no.” If the subliminal presentation was effective, individuals' rates of correct response would be expected not to significantly differ than the success rate predicted by chance (i.e., 50%).

Parent Bodily Pain and General Physical Health

The 36-item Short Form Health Survey (SF-36; Ware & Sherbourne, 1992) assesses eight domains of health perception, including 1) limitations in physical activities due to health problems, 2) limitations in social activities due to physical or emotional problems, 3) limitations in usual role activities due to physical health problems, 4) bodily pain, 5) general mental health, 6) limitations in usual role activities due to emotional problems, 7) energy and fatigue, and 8) general health perceptions. The indices of Bodily Pain and General Health perceptions were used in the current study. The Bodily Pain scale consists of two items. The first item assesses the degree of bodily pain the individual has experienced in the past four weeks, using a 6-point scale with responses ranging from "none" to "very severe;" the second item assesses the extent to which pain

has interfered with work inside and outside of the home, with responses ranging from "not at all" to "extremely," on a 5-point scale. The General Health perceptions scale consists of five items. One item asks participants to provide a general rating of their health using a 5-point scale with responses ranging from "excellent" to "poor." The remaining four items are rated using a 5-point scale ranging from "definitely true" to "definitely false", and assess participants' beliefs about their health both generally and in comparison to others and their expectation of future health. Raw scores on the SF-36 are transformed so that scores range from 0 to 100, with higher scores indicating a better health state (see Ware, Snow, Kosinski & Gandek, 1993). Therefore, higher scores on the Bodily Pain scale indicate freedom from pain, and higher scores on the General Health scale indicate perceptions of good health. Test-retest reliability and internal consistency for the Bodily Pain and General Health scales have been reported to be adequate (e.g., Brazier et al., 1992). In this sample, the Cronbach's alpha coefficient for the Bodily Pain scale was .92, indicating that 92% of variation in individuals' reported scores was due to true score variance (Crocker & Algina, 1986, p. 139). Cronbach's alpha for the General Health scale was .82 in the current study.

Parent Symptoms of Functional GI Disorders and Abdominal Pain

All participating parents completed the 38-item Rome II Modular Questionnaire (Drossman, Corazziari, Talley, Thompson & Whitehead, 2000). This questionnaire is a self-report measure of FGID symptoms based on the Rome II criteria. Parents were asked to endorse symptoms that they experienced "often", defined as "present during at least 3 weeks (at least one day in each week) in the last 3 months". Based on their self-reported

symptoms, 14 parents of pain-free children (19%) and 25 parents of CAP patients (33%) reported symptoms of pain-related FGIDs, including Functional Dyspepsia, IBS, Unspecified Functional Bowel Disorder, Functional Abdominal Pain Syndrome and Unspecified Functional Abdominal Pain. Two items on the Rome II Modular Questionnaire specifically assess the presence abdominal pain. Nineteen parents of pain-free children (26%) and 30 parents of CAP patients (40%) endorsed at least one of these items, indicating that they had experienced abdominal pain or discomfort “often” in the three months prior to the study.

Parent Anxiety Symptoms

Parents completed the Beck Anxiety Inventory (BAI; Beck & Steer, 1990), a 21-item questionnaire assessing both physiological and cognitive components of anxiety. Parents were asked to indicate, using a four-point scale, the extent to which each symptom of anxiety had affected them in the past week. Response categories range from "not at all" (0) to "severely" (3). Previous research has shown the BAI to have adequate convergent validity and high internal consistency, assessed using Cronbach's alpha. In this sample, Cronbach’s alpha was .91. Scores on the BAI have been found to be uncorrelated with education, marital status, or age (Osman, Kopper, Barrios, Osman & Wade, 1997).

Appraisals of Children's Pain and Coping

Parents of CAP patients completed the parent-report form of the Pain Beliefs Questionnaire (PBQ; Walker, Smith, Garber & Claar, 2005) during their initial visit to

the gastroenterology clinic. The PBQ consists of thirty-two items, each representing a specific appraisal about children's pain severity and coping abilities. Items assess the extent to which parents believe each statement to be true about the child. Responses are on a 5-point scale and range from "not at all true" (0) to "very true" (4). PBQ scales reflect Lazarus and Folkman's distinction (1984) between primary and secondary appraisals. The Primary Appraisal scale assesses parents' appraisals of children's pain severity, and consists of 20 items. There are two subscales that assess secondary appraisals, or parents' appraisals of their children's ability to cope with pain. The scale reflecting Problem-Focused Coping Potential (i.e., parents' beliefs about children's abilities to alleviate pain and symptoms) consists of 6 items, and the scale representing Emotion-Focused Coping Potential (i.e., parents' beliefs about children's abilities to alleviate emotional distress accompanying pain and symptoms) also consists of 6 items. In this sample, Cronbach's alpha coefficient was .80 for the Primary Appraisal and Problem-Focused Coping Potential (PFCP) scales. Cronbach's alpha coefficient was .75 for the Emotion-Focused Coping Potential (EFCP) scale.

Procedure

The PBQ was completed by parents of CAP patients during their initial visit to the Gastroenterology Clinic at Vanderbilt Children's Hospital. Following phone screening for eligibility, participating families were assigned appointments to participate in the lab study. All lab appointments were conducted in research space in an academic building. All eligible parents completed the dot probe task, SF-36, Rome II Modular Questionnaire, and BAI during a single study session. After giving informed consent for

their own and their children's participation, parents were seated at a computer desk to complete the dot probe task. Immediately following the dot probe task, parents completed the lexical decision task, which served as the validity check for the subliminal presentation condition of the dot probe task. Next, parents completed questionnaire measures; during this time, the research assistant was available to answer questions. While parents were participating in the study, their children were completing study tasks in an adjacent room. At the end of the appointment, research assistants explained the purpose of the dot probe task and compensated families $50 for their participation.

CHAPTER III

RESULTS

Characteristics of Parents of CAP Patients and Parents of Pain-free Children

Demographic Characteristics

Of the 76 parents of CAP patients who accompanied their children to their research appointments, two did not complete the dot probe due to a malfunction of the computer drive on which the dot probe program operated. Subsequently, complete data were available for 74 parents of CAP patients and for all 73 participating parents of pain-free children. As indicated in Table 2, there were no significant age differences between groups of participating parents, $F(1, 137) = 2.01$, $p > .05$, and the percentage of mothers versus fathers did not differ significantly by parent group, $\chi^2(1, n = 147) = .001$, $p > .05$. Table 2 describes demographic, physical, and psychological characteristics of parents of CAP patients and parents of pain-free children.

Parent Bodily Pain and General Physical Health

Parents of CAP patients reported significantly more bodily pain, indicated by lower scores on the measure of freedom from pain, $F(1, 145) = 8.93$, $p < .05$, than parents of pain-free children. Levels of bodily pain reported by parents of CAP patients in this study ($M = 67.11$, $SD = 26.45$) was greater than that reported by individuals with chronic regional ($M = 77.5$, SD not reported) or widespread pain ($M = 74.8$, SD not reported) and

Table 2

Demographic, Physical and Psychological Characteristics of Participating Parents

	Total	*Parents of CAP patients* n = 74	*Parents of pain-free children* n = 73
Age *M (SD)*	41.62 (6.17)	42.33 (6.38)	40.85 (5.88)
Gender *% female*	83.7%	83.8%	83.6%
General health (SF-36) *M (SD)*	73.67 (20.08)	71.28 (21.50)	76.12 (18.34)
Bodily pain (SF-36) *M (SD)*	72.74 (23.71)	67.11 (26.45) [a]	78.53 (19.01) [b]
Pain-related FGID symptoms *% endorsing*	27.1%	33.8%	20.0%
Frequent abdominal pain *% endorsing*	33.6%	40.5%	26.4%
Anxiety symptoms (BAI) *M (SD)*	7.12 (7.51)	8.75 (8.71)[a]	5.42 (5.59)[b]
Parent Appraisals of Child's:			
Pain severity	-	2.03 (0.56)	-
Problem-focused coping potential	-	1.61 (0.80)	-
Emotion-focused coping potential	-	2.51 (0.78)	-

Note. Means with different subscripts differ significantly at p<.05.

similar to that reported by individuals with advanced or complicated chronic medical conditions (*M* = 65.1, *SE* = 2.06) in large studies of health status in the general population (Bergman, Jacobsson, Herrström & Petersson, 2004; McHorney, Ware & Raczek, 1993).

In comparison, parents of pain-free children in the current study reported slightly more pain (M = 78.53, SD = 19.01) than pain-free individuals (M = 87.8, SD not reported) and similar levels of bodily pain to patients with uncomplicated or minor chronic medical conditions (M = 76.06, SE = 0.91) participating in large, population-based studies (Bergman, Jacobsson, Herrström & Petersson, 2004; McHorney, Ware & Raczek, 1993).

Differences between parents of CAP patients and parents of pain-free children on ratings of general health were not statistically significant. Across parent groups, reported perceptions of general health (M = 73.67, SD = 20.08) were more negative than those of pain-free individuals in a community sample (M = 85.2, SD not reported) (Bergman et al., 2004) but more positive than those reported by patients with chronic medical conditions (minor conditions, M = 67.02, SE = 0.74; serious conditions, M = 49.13, SE = 1.80) or psychiatric conditions (M = 57.91, SE = 1.75) (McHorney et al., 1993).

Two parents of CAP patients reported levels of bodily pain that were more than three standard deviations from the total sample mean. Compared to the mean Bodily Pain score reported by parents of CAP patients, alone, these outlying scores fell within the expected range of three standard deviations in either direction of the mean. Because parents of CAP patients in this study reported greater levels of bodily pain than parents of pain-free children, and because neither score remained an outlier when compared to the mean for parents of CAP patients, alone, these scores were considered representative of this sample and were included in all analyses.

On the General Health scale, there was a single outlying score greater than three standard deviations from the total sample mean. Specifically, one parent of a CAP patient reported an unusually low level of general health in comparison both to the mean level of

general health reported in the total sample and to the mean level of general health reported by parents of CAP patients, only. In order to reduce any undue influence of this outlying score, which was extreme even in comparison to levels of general health for parents of CAP patients, it was winsorized prior to subsequent analyses.

Parent Symptoms of Functional GI Disorders and Abdominal Pain

The frequency of pain-related FGID symptoms reported by parents of CAP patients was marginally significantly higher than the frequency reported by parents of pain-free children, $\chi^2(1, n = 144) = 3.46, p = .06$. This is consistent with findings that mothers of children with CAP have more somatic and pain symptoms than mothers of pain-free children (Campo et al., 2007; Walker & Greene, 1989). Across groups, 27% of parents endorsed clinically significant symptoms of pain-related FGIDs, with Irritable Bowel Syndrome (IBS) being the most common FGID for which parents endorsed symptoms. Of 49 parents endorsing clinically significant FGID symptoms, 30 (61%) reported symptoms consistent with the Rome II criteria for IBS. Otherwise stated, 20% of the total sample reported IBS symptomatology. This report is consistent with findings of community-based studies, which have reported the prevalence of IBS to range from 5 to 22% (Halder et al., 2007; Hillilä, Siivola & Färkkilä, 2007; Jones & Lydeard, 1992).

Parents in the current sample appeared more likely to endorse frequent abdominal pain than are adults in the general population. In a recent longitudinal, population-based study of the prevalence of abdominal pain and functional GI disorders, Halder and colleagues reported that 20% of adults endorsed frequent abdominal pain, compared to 34% of parents in the current sample. There was a trend for parents of CAP patients to

report abdominal pain with more frequency than parents of pain-free children, $\chi^2(1, n = 146) = 3.28, p = .07$.

Parent Anxiety Symptoms

Parents of CAP patients and pain-free children reported relatively low levels of anxiety symptoms, although large standard deviation values indicated considerable variability in individual scores. Mean scores for each parent group, depicted in Table 2, fell between those reported by adults without anxiety disorders ($M = 2.5$, $SD = 2.8$) and adults with generalized anxiety disorder ($M = 10.3$, $SD = 7.4$) (Leyfer, Ruberg & Woodruff-Borden, 2006), and were similar to BAI scores in a census-representative sample of adults between the ages of 18 and 44 years, ($M = 7.3$, $SD = 8.4$) (Gillis, Haaga & Ford, 1995). Anxiety symptoms reported by parents in the current study were well below the mean scores reported by adults being treated for anxiety disorders in outpatient settings ($M = 23.9$, $SD = 3.7$) (Fydrich, Dowdall & Chambless, 1992). Parents of CAP patients reported significantly more symptoms of anxiety, $F(1, 145) = 7.41$, $p < .05$, compared to parents of pain-free children.

Four parents' scores on the BAI were outlying (i.e., greater than three standard deviations above the mean BAI score in the total sample). Specifically, three parents of CAP patients and one parent of a pain-free child reported outlying scores indicating higher levels of anxiety symptoms than other parents in their respective groups. Compared to the mean BAI scores for their respective groups (i.e., parents of CAP patients, parents of pain-free children), these individuals' BAI scores maintained their outlying status. When removed from the data, the between-groups difference in reported

anxiety symptoms remained significant, $F(1, 140) = 4.32$, $p = .04$, indicating that these outlying scores were not solely accountable for the higher level of anxiety symptoms reported by parents of CAP patients. This robust difference in anxiety symptoms reported by parents of CAP patients and parents of pain-free children is consistent with previous empirical findings showing that parents of CAP patients exhibit heightened symptoms of emotional distress compared to parents of non-patients (e.g., Walker & Greene, 1989). Because parents' inclusion in the present study was unrelated to reported levels of anxiety, the four outlying data points were considered representative of the parent population from which this sample was drawn and were therefore retained in all further analyses.

Appraisals of Children's Pain and Coping

Parents of CAP patients reported appraisals of the severity of their children's pain and their children's efficacy in enacting problem- and emotion-focused coping strategies on the PBQ. In most cases, parents completed the questionnaire prior to their child's physical examination by the gastroenterologist. Parents' reports of primary appraisals ($M = 2.03$, $SD = 0.56$) were within one standard deviation of previously reported maternal appraisals of children's pain severity on the PBQ ($M = 2.34$, $SD = 0.63$) (Van Slyke, 2001). In the current study, parents' reports of their children's emotion-focused coping potential ($M = 2.51$, $SD = 0.78$) were slightly elevated compared to their reports of children's problem-focused coping potential ($M = 1.61$, $SD = 0.80$). This observation also is consistent with previously reported data (EFCP: $M = 2.19$, $SD = 0.87$; PFCP: $M = 1.28$,

SD = 0.72) (Van Slyke, 2001). In the current study, there were no outlying scores on measures of parents' primary or secondary, and all data were used in further analyses.

Validity of the Subliminal Exposure Condition

The subliminal exposure condition is considered valid if individuals' identification of subliminally-presented stimuli as "real" or "nonsense" words in the lexical decision task is no more accurate than would be expected by chance (50% accuracy). Two methods were used to examine the validity of the subliminal exposure condition. First, a t-test used to examine the difference between obtained accuracy (*M* = .48, *SD* = .06) and expected accuracy (.50) on subliminal trials of the lexical decision task revealed that participants' accuracy in identifying "real" and "nonsense" words was significantly lower than predicted by chance, $t(146) = -3.99$, $p < .05$. This result suggests that the timing and execution of the subliminal trials successfully prevented words from entering conscious awareness.

The validity of the subliminal exposure condition also was examined by comparing the number of attained accurate responses to the 95% confidence interval around the expected number of accurate responses. The lower limit for the confidence interval was identified by subtracting the product of the predicted standard deviation and the critical t-value from the predicted mean. The upper limit for the confidence interval was identified as the sum of the predicted mean and the product of the predicted standard deviation and the critical t-value. Predicted means and standard deviations arise from the theoretical distribution of accurate responses to the lexical decision task. The lexical decision task consisted of 18 trials; by chance, participants were expected to provide

accurate responses to 50% of the trials. Therefore, the predicted mean number of accurate responses is 9. There are two mutually exclusive possible responses to each trial of the lexical decision task. Therefore, the expected variance of lexical decision task responses is calculated from the number of trials and the probability of each response (18 * .50 * .50), and the square root of this product is the expected standard deviation. There were 18 trials of the lexical decision task, and 17 degrees of freedom. Therefore, the critical value of the two-tailed t-distribution with alpha of .05 is 2.11. The limits for the 95% confidence interval were calculated as $9 \pm (2.12 * 2.11)$. As a result, the number of accurate responses to the lexical decision task was expected to fall between the lower limit (4.53) and the upper limit (13.47) of the confidence interval for 95% of participating parents. Because the lexical decision task consisted of categorical response choices, the upper and lower limits of the 95% confidence interval were rounded to integers (i.e., 5 and 13). In the total sample, 146 (99%) parents responded accurately to between 5 and 13 trials of the lexical decision task. A single parent responded accurately to only 4 trials. The fact that only one parent provided fewer accurate responses than predicted by the 95% confidence interval around the number of accurate responses expected by chance suggests that, across the sample, the subliminal presentation condition was effective.

Response Latency Data Cleaning

In order to gain meaningful results when analyzing response latency data, it was necessary to identify response latencies that may have reflected processes other than those of direct interest (Ratcliff, 1993). This study adopted data cleaning techniques employed by previous studies using the dot probe methodology (e.g., Boyer, 2006;

Lipani, 2007) to address extreme scores, inaccurate responses, and outlying response latencies.

Extreme Scores

Each of the 147 participating parents completed 120 dot probe trials; thus 17,640 total trials of the dot probe were administered. Previous studies have excluded probe detection latencies shorter than 100 milliseconds and longer than 4000 milliseconds (e.g., Boyer, 2006; Lipani, 2007). In the current study, there were no response times less than 100 milliseconds and 3 (< .001%) response times greater than 4000 milliseconds. The 3 response times greater than 4000 milliseconds were removed from further analyses.

Inaccurate Responses

Of 17,640 completed dot probe trials, there were 122 inaccurate responses (0.7%). The number of inaccurate responses by parents of CAP patients ranged from 0 – 18, with 37 parents (50%) making no inaccurate responses and 36 parents (49%) providing between 1 and 5 inaccurate responses. Only one parent of a CAP patient provided more than 5 inaccurate responses; this individual made 18 inaccurate responses on dot probe trials. The number of inaccurate responses by parents of pain-free children ranged from 0 – 3, with 39 (53%) making no inaccurate responses. A chi-square test examining whether the frequency of inaccurate responding differed significantly between parent groups was non-significant, $\chi^2(6, n = 147) = 5.47, p > .05$. Following procedures used by other researchers using the dot probe paradigm (e.g., Boyer et al., 2006; Keogh et al., 2001; Lipani et al., 2007; Salemink et al., 2007; Van Damme et al., 2004; Waters,

Nitz, Craske & Johnson, 2007) all response latencies corresponding to inaccurate responses were removed from further analyses.

Outlying Response Latencies

Response latencies that were two standard deviations or more from an individual's own mean were identified as within-subject outliers. This criterion is similar to procedures employed by other researchers using dot probe paradigms (e.g., Waters et al., 2007). In the total sample, 75 parents (51%) provided at least one response that was two standard deviations or more below their individual mean response time, across trials. These outlying response latencies represent trials on which parents responded unusually quickly. For both groups of parents, the number of outlying response times below the individuals' mean response times ranged from 0 – 4, with a mode of 0. A chi-square test examining whether the frequency of outlying response times below individuals' means differed between groups was non-significant, $\chi^2(4, n = 147) = 5.76, p > .05$. In comparison, all 147 parents in the total sample exhibited at least one response time that was two standard deviations or more above their individual mean response time, across trials. These outlying response times represent trials on which parents responded unusually slowly. For parents of CAP patients, the number of outlying response times above the mean ranged from 1 – 7, with a mode of 3. For parents of pain-free children, the number of outlying response times above the mean ranged from 1 – 8, with a mode of 4. A chi-square test examining group differences in the frequency of outlying response times above individuals' mean response times was non-significant, $\chi^2(7, n = 147) = 6.40$, $p > .05$. All within-subject outlying response times were removed from further analyses.

Overall, cleaning the response latency data resulted in excluding data from less than five percent of trials (i.e., 864 out of 17,640 trials: 3 trials due to extreme scores, 122 trials due to inaccurate responses, and 739 due to within-subject outliers).

Effects of Word Type, Word Position, and Threat Position

Prior to examining specific hypotheses concerning parents' attention to pain-relevant words, it is necessary to demonstrate that variability in their response times to probed stimuli reflects the impact of manipulated variables. Other researchers using the dot probe task have proposed that a significant interaction of probe position and threat position on raw response latencies to threat-neutral trials indicates the presence of selective attention either toward or away from threat words (e.g., Asmundson et al., 1997; Koster et al., 2004; MacLeod et al., 1986). Therefore, evidence for a significant interaction effect of probe position and threat position on raw response latencies is often considered a prerequisite for subsequent analyses. Consistent with this standard, the current study conducted preliminary analyses to examine the impact of probe position and threat position, among other variables, on parents' raw response latencies to dot probe trials.

Initially, a 2 x 2 x 2 x 2 x 2 repeated measures ANOVA was used to identify significant main effects or interactions of manipulated within-subjects variables or the single between-subjects variable, parent group (parents of CAP patients vs. parents of pain-free children). The four within-subjects variables were word type (threat or neutral), exposure condition (subliminal or supraliminal), threat word position (upper or lower) and probe position (upper or lower). In this analysis, dependent variables were mean

response latencies to dot probe trials. Mean response latencies were calculated separately for all combinations of threat-neutral and neutral-neutral word pairs, supraliminal and subliminal exposure conditions, probe location, and threat location. (For neutral-neutral word pairs, one word was arbitrarily assigned as the "target" word during programming of the dot probe task. Thus, for neutral-neutral trials, threat location (upper or lower) was based on the position of the "target" word).

The 2 x 2 x 2 x 2 x 2 repeated measures ANOVA revealed a significant main effect for word type, $F(1,145) = 12.09$, $p < .05$. Parents exhibited longer response latencies to threat-neutral word pairs ($M = 613.16$, $SE = 11.88$) than to neutral-neutral word pairs ($M = 601.83$, $SE = 11.76$), regardless of subliminal or supraliminal presentation, threat (or "target") position, or probe position. There also were significant two-way interactions of exposure type and threat position, $F(1, 145) = 3.93$, $p < .05$ and of exposure type and probe position, $F(1, 145) = 11.90$, $p < .05$. However, these effects were subsumed under the significant three-way interaction of exposure type, threat position and probe position, $F(1, 145) = 15.20$, $p < .05$.

This preliminary analysis was subsequently recognized as being overly inclusive, as the presence of a significant interaction of probe position and threat position on the response times from threat-neutral trials, alone, would provide sufficient evidence of differential attention toward pain-relevant compared to neutral words. Thus, the inclusion of raw response latencies for neutral-neutral trials and of word type (threat vs. neutral) as a within-subjects factor was not required to examine the presence of biased attentional processing. Consequently, a secondary repeated measures ANOVA was conducted, using raw response latencies for threat-neutral trials, only, as dependent

variables. As before, parent group (parents of CAP patients vs. parents of pain-free children) was the only between-subjects factor. This secondary analysis included only three within-subjects variables: exposure condition (subliminal or supraliminal), threat word position (upper or lower), and probe position (upper or lower). Table 3 presents the mean response latencies for threat-neutral trials included in this analysis. Results of this secondary repeated-measures ANOVA was consistent with the initial repeated-measures test, in that the significant two way interactions of exposure by threat position, F (1, 145) = 5.39, p <.05 and exposure by probe position, F (1, 145) = 4.28, p <.05 were subsumed under a significant three way interaction of exposure, threat position and probe position, F (1, 145) = 6.63, p <.05.

In order to better understand the nature of the significant interaction of exposure condition, threat position and probe position, a series of 28 paired-samples t-tests compared response latencies for each trial type to response latencies for every other trial type. Because the main effect of parent group was not significant, the mean response latencies for the total sample were used in this analysis. These means and the results of paired-sample tests appear in Table 4. As indicated in Table 4, response latencies to supraliminal trials in which the threat word appeared in the lower position and the probed neutral word appeared in the upper position were significantly delayed compared to all other trial types. Differences between response latencies for other trial types did not reach statistical significance. This finding shows that parents in this study exhibited delayed responding to trials in which probed neutral words appeared in the upper position, suggesting attentional bias toward the pain-relevant words appearing in the lower position.

Table 3.

Mean Response Latencies (in Milliseconds) and Standard Deviations for Threat-Neutral Word Pairs Presented in the Dot Probe

Exposure	*Threat word position*	*Probe position*	*Total*		*Parents of CAP patients*		*Parents of pain-free children*	
			M	*SD*	*M*	*SD*	*M*	*SD*
Supraliminal	Up	Up	605.50	151.74	616.35	164.28	594.50	138.14
		Down	605.86	139.73	621.53	143.45	589.97	134.98
	Down	Down	605.71	155.82	619.46	171.84	591.77	137.50
		Up	637.47	168.54	659.59	186.91	615.04	145.48
Subliminal	Up	Up	613.99	166.79	626.91	168.36	600.89	165.30
		Down	614.63	159.01	638.69	169.02	590.24	145.27
	Down	Down	614.78	165.73	627.19	179.60	602.20	150.57
		Up	608.24	160.56	622.69	171.73	593.60	148.14

Table 4.

Mean Response Times (in Milliseconds) and Standard Deviations for Dot Probe Trials Involved in the Significant Exposure x Threat Position x Probe Position Effect

	Threat Up, Probe Up	Threat Up, Probe Down	Threat Down, Probe Down	Threat Down, Probe Up
Supraliminal	605.50(151.74)[a]	605.86(139.73)[a]	605.71(155.82)[a]	637.47(168.54)[b]
Subliminal	613.99(166.79)[a]	614.63(159.01)[a]	614.78(165.73)[a]	608.24(160.56)[a]

Note. Means with different subscripts differ significantly at $p<.01$

Calculation of Attention Indices

The continuous attentional bias index (AB) describes the within-subjects effects of probe position (upper or lower) and threat word position (upper or lower) on response latencies to threat-neutral trials. The current study employs a widely used attentional bias index (see Boyer et al., 2006; Keogh et al., 2001; Lipani, 2007) calculated using the formula [(UPLT-UPUT) + (LPUT - LPLT)]/2. Within this formula, "P" indicates the location of the probe, "T" indicates the location of the threat word, and "U" and "L" indicate the positions in which the probe (P) and threat (T) are located. Therefore, the unit "UPLT" represents mean response latencies to threat-neutral trials in which the probe appears in the upper position and the threat word appears in the lower position. For each participant, two AB index scores were calculated. The index "ABsub" was computed from individuals' response latencies to trials in which word pairs were presented subliminally (i.e., for 20 milliseconds). The index "ABsup" was computed from response latencies to trials in which word pairs were presented supraliminally (i.e., for 1250 milliseconds). On the AB index, positive scores indicate selective attention toward pain-

relevant stimuli and negative scores indicate selective attentional avoidance of pain-relevant stimuli. An AB index score of zero indicates that the individual does not display selective attention with reference to the specific threat words employed in this study. The attentional bias indices (ABsub and ABsup) were used to test the specific hypotheses of the current study.

Additionally, exploratory analyses were conducted using a more specific bias index informed by preliminary analyses. As reported previously, parents in the current study exhibited attentional bias toward threat only on supraliminal threat-neutral trials in which pain-relevant words appeared in the lower position and probed neutral words appeared in the upper position. Therefore, an exploratory index of attentional bias was computed only for supraliminal threat-neutral trials in which threat words appeared in the lower position. Using the same conventions as the ABsub and ABsup indices, this sample-specific index of attention bias was computed using the formula (UPLT- LPLT). This index, labeled "ABexp" was subjected to the same analyses as the ABsub and ABsup indices.

The current study also proposed exploratory hypothesis testing using indices of attentional vigilance and disengagement. As reported previously, initial preliminary analyses revealed a significant difference between response latencies to threat-neutral and neutral-neutral trials, as indicated by a significant main effect of "word type". The impact of this finding on the computation of continuous indices of attentional vigilance and disengagement posed a challenge to interpreting findings related to these indices. In fact, significant differences in response latencies to threat-neutral and neutral-neutral trials may render such indices unusable. Consequently, results of exploratory analyses

employing indices of vigilance and disengagement will not be reported alongside results employing the attentional bias indices. The current study's findings regarding indices of vigilance and disengagement will follow results of hypothesis testing.

Index Score Data Cleaning

After calculating index scores, between-subject outliers were identified as individual scores greater than three standard deviations above or below the mean scores for each of the attentional bias indices (ABsub, ABsup, ABexp) in each parent group, separately. The criterion for removing between-subjects outliers was more conservative than that used for within-subjects outliers (i.e., three instead of two standard deviations from the mean) in order to limit data exclusion to those cases with extremely unusual index scores. Among parents of CAP patients, three individuals had outlying index scores. Among parents of pain-free children, one individual had an outlying index scores. The number of outlying scores on each index is presented in Table 5.

Table 5.

Number of Outlying Scores on Attentional Bias Indices

	Individual index score 3 or more SD above mean		*Individual index score 3 or more SD below mean*	
	Parent of CAP patients	Parents of pain-free children	Parent of CAP patients	Parents of pain-free children
ABsup	-	-	-	1
ABsub	2	-	1	-
ABexp	-	-	-	-

To determine the impact of between-subject outliers, results of analyses using the full dataset (including scores for these outlying cases) were compared to results of analyses conducted on data with outlying index scores with removed. When outlying index scores were removed from the data, results varied slightly from those found in the full data set. Therefore, to minimize the impact of between-subjects outliers, outlying scores on each index of attentional bias were removed from subsequent analyses. Table 6 displays the values for the attentional bias indices in the total sample and also separately for parents of CAP patients and parents of pain-free children, after removal of between-subjects outlying scores. As noted in previous studies, the mean index scores were small, with large standard deviations (e.g., Asmundson, Carleton et al., 2005; Roelofs et al., 2005). Figure 1 displays the mean attentional bias indices for parents of CAP patients and pain-free children.

Table 6

Attentional Bias Indices in Total Sample and by Group

	Total sample			*Parents of CAP patients*			*Parents of Pain-free children*		
	M	*SD*	*range*	*M*	*SD*	*range*	*M*	*SD*	*range*
ABsup	17.31*	62.33	-176.1 – 207.8	22.66	70.65	-176.1 – 207.8	11.81	52.36	-107.3 – 156.2
ABsub	-4.64	62.45	-209.9 – 180.7	.50	57.34	-138.5 – 163.1	-9.63	67.06	-209.9 – 180.7
ABexp	31.76*	84.94	-195.6 – 278.6	40.13	90.81	-184.8 – 278.6	23.27	78.27	-195.6 – 238.2

* Index score in total sample differs significantly from zero, $p < .05$.

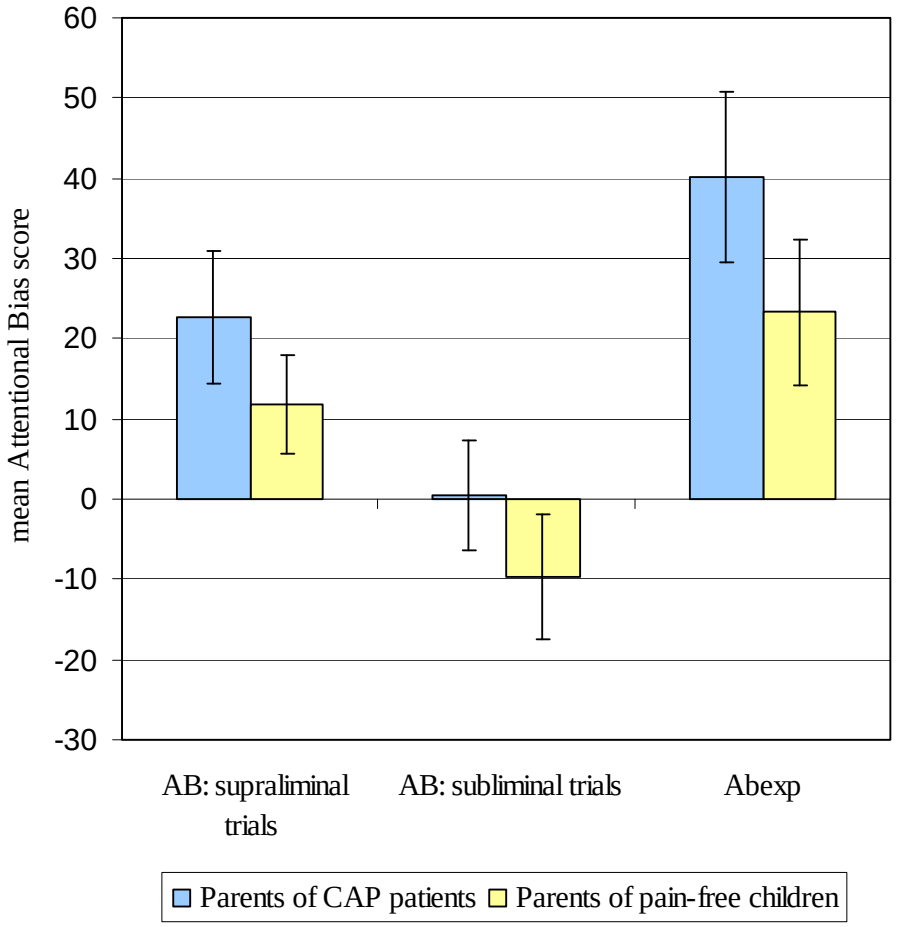

Figure 1. Mean attentional bias scores and standard errors for parents of CAP patients and parents of pain-free children

Primary Data Analyses

Hypothesis 1: Attentional Bias toward Pain-relevant versus Neutral Stimuli

Two one-sample t-tests examined the hypothesis that, across groups of parents, indices of attentional bias would be significantly greater than zero. Among all parents, attentional bias toward pain threat words compared to neutral words was significantly greater than zero, $t(145) = 3.36$, $p = .001$, when words were presented supraliminally, but not subliminally, $t(143) = -0.89$, $p = .38$. Thus, in partial support of study hypotheses, parents of CAP patients and parents of pain-free children exhibited statistically significant attentional bias toward threat words presented supraliminally. An exploratory one-sample t-test using the alternative attentional bias index, representing response latencies to trials in which threat words were presented in the lower position, also was statistically significant, $t(146) = 4.53$, $p = <.001$. This significant finding suggests that parents exhibited a meaningful degree of selective attention toward supraliminally presented threat words appearing in the lower position of the screen, compared to neutral words.

Hypothesis 2: Differences in Attentional Patterns Exhibited by Parents of CAP Patients and Parents of Pain-free Children

In order to test the hypothesis that parents of CAP patients exhibited greater attentional bias to pain threat words than parents of pain-free children, a multiple analysis of variance (MANOVA) was used to compare each attentional bias index (ABsub and ABsup) between groups of parents. The MANOVA was non-significant ($\Lambda = .99$, $p > .05$). Contrary to the hypothesis, parents of CAP patients did not exhibit greater

attentional bias toward pain-relevant stimuli presented supraliminally or subliminally, in comparison to parents of pain-free children. In order to examine whether parents of CAP patients and parents of pain-free children differed in their response latencies to the specific trials in which significant attentional bias was exhibited, an exploratory ANOVA examined between-groups differences on the ABexp variable. Parents of CAP patients and parents of pain-free children did not differ on this specific measure of attentional bias to supraliminally presented threat words in the lower position, $F(1, 145) = 1.45$, $p > .05$.

In order to explore whether parents of CAP patients and parents of pain-free children differed in their attentional responses to supraliminally versus subliminally presented pain-relevant words, results of the preliminary 2 x 2 x 2 x 2 repeated-measures ANOVA were examined. In this analysis, the main effect of exposure condition was not significant, $F(1, 145) = .04$, $p > .05$ and the interaction of parent group and exposure condition also failed to reach statistical significance, $F(1, 145) = 0.10$, $p > .05$.

In order to examine the secondary hypothesis that parents with medical histories significant for IBS or other FGIDs characterized by abdominal pain exhibited greater attentional bias to pain-relevant stimuli than parents without significant medical histories, a MANOVA was employed. The attentional bias indices (ABsub and ABsup) were entered as dependent variables, and there was a single between-subjects variable (i.e., symptomatic versus asymptomatic). According to their self-report on the Rome II Modular Questionnaire, 39 parents in the total sample met criteria for one or more pain-related FGIDs, while the remaining 105 parents did not meet criteria for pain-related FGIDs. Three parents did not complete sections of the Rome II Modular Questionnaire necessary for determination of pain-related FGID status and were therefore excluded

from this analysis. The MANOVA comparing indices of attentional bias toward pain-relevant stimuli between parents with symptoms of pain-related FGIDs and those without FGID symptoms was non-significant (Λ= .99, p > .05). An additional ANOVA examining whether parents with pain-related FGID symptoms differed from parents without such symptoms on the sample-specific index of attentional bias (ABexp) failed to reach statistical significance, $F(1, 142) = 0.68$, p >.05.

A final MANOVA was conducted to examine whether parents who reported frequent abdominal pain or discomfort exhibited greater attentional bias to pain-related words than parents without frequent abdominal pain. Two items on the Rome II Modular Questionnaire assessed parents' experiences of abdominal pain. In the total sample, 49 parents endorsed experiencing abdominal pain or discomfort at least once weekly during at least three weeks out of the previous three months (i.e., "often"), while 97 parents did not report significant abdominal pain or discomfort. One parent did not complete the Rome II Modular Questionnaire and was therefore excluded from this analysis. The MANOVA examining whether these groups of parents exhibited differences on either index of attentional bias was non-significant (Λ= .97, p > .05). An ANOVA examining whether parents with and without frequent abdominal pain exhibited differing degrees of attentional bias on the sample-specific ABexp index also failed to reach significance, $F(1, 144) = 1.49$, p >.05.

Hypothesis 3: Relation of Attentional Bias to Physical and Psychological Characteristics

In order to examine the hypothesis that parents' attentional bias to pain-relevant stimuli was related to their reported bodily pain, physical health, and anxiety symptoms,

Pearson correlations were calculated between the attentional bias indices (ABsub and ABsup) and measures of parents' physical and psychological characteristics. Correlations across both parent groups and also within each group, separately, are reported in Table 7. It was expected that index scores would be significantly negatively correlated with parents' ratings of their freedom from bodily pain and general health and significantly positively correlated with parents' self-reported symptoms of anxiety.

In the full sample, only the correlation of attentional bias to subliminally presented pain threat words (ABsub) with general health was significant (r = -.18, p <.05). This result was in the expected direction: greater attentional bias to pain-relevant words was correlated with poorer perceived general health. Similarly, among parents of pain-free children, the correlations between freedom from bodily pain (r = -.29, p <.05) and general health (r = -.37, p <.05) were significant and negative, as predicted. That is, among parents of pain-free children, lower levels of freedom from bodily pain (i.e., higher levels of pain) and poorer general health were associated with a greater degree of attentional bias toward subliminally presented pain-relevant words. In contrast, significant correlations between attentional bias, bodily pain and general health were in the opposite direction for parents of CAP patients, contradicting study hypotheses. Specifically, among parents of CAP patients, attentional bias to supraliminally-presented pain-relevant words was positively correlated with parents' freedom from pain (r = .23, p <.05) and perceptions of general health (r = .26, p <.05). That is, among parents of CAP patients, higher levels of freedom from bodily pain (i.e., lower levels of pain) and higher levels of general health were associated with greater attentional bias to pain-relevant words presented to conscious awareness. Exploratory correlations of bodily pain, general

health and anxiety symptoms with the sample-specific attentional bias index calculated from the specific trials on which parents exhibited the greatest attentional bias (ABexp) failed to reach significance, as indicated in Table 7.

Table 7.

Pearson Correlations of Attentional Bias Indices with Pain, General Health, and Anxiety

	ABsub	ABsup	ABexp
		Total sample n = 147	
Bodily pain	-.13	.15	.08
General health	-.18*	.16	.02
Anxiety symptoms	.14	-.12	-.016
		Parents of CAP patients n = 74	
Bodily pain	.02	.23*	.09
General health	.01	.26*	.06
Anxiety symptoms	.15	-.12	-.06
		Parents of pain-free children n = 73	
Bodily pain	-.29*	.06	.13
General health	-.37*	.02	-.01
Anxiety symptoms	.11	-.14	.01

* Pearson correlation is statistically significant, p <.05

Hypothesis 4: Relation of Attentional Bias to Parent Appraisals of Children's Pain and Coping

In order to test the hypothesis that parents' attentional bias to threat was related to their beliefs about their children's pain severity and coping abilities, Pearson correlations were calculated between each attentional bias index (ABsub and ABsup) and parents' primary appraisals of their children's pain severity and secondary appraisals of their children's pain coping efficacy. Parents' appraisals were assessed with the Pain Beliefs Questionnaire (PBQ) administered during patients' initial visits to the tertiary care clinic; accordingly, these correlations were calculated for parents of CAP patients, only. Of the 74 parents of CAP patients participating in the current study, 69 completed the Pain Beliefs Questionnaire during their visit. The remaining 5 parents did not participate in questionnaire completion at the clinic, but agreed to participate in the current study.

Results of correlational analysis appear in Table 8. It was expected that the attentional bias indices would be positively correlated with primary appraisals (i.e., greater attentional bias would be associated with appraisals of greater pain severity) and negatively correlated with secondary appraisals (i.e., greater attentional bias would be associated with appraisals of lower perceived coping efficacy). However, results revealed no significant relation between indices of attentional bias and parents' primary appraisals of their children's pain severity or secondary appraisals of children's problem-focused or emotion-focused coping potential. Additionally, Table 8 depicts results of exploratory analyses of the relation between parents' appraisals and the attentional bias index calculated only from response latencies to trials on which parents exhibited significant attentional bias (ABexp). These correlations also failed to reach significance.

Table 8.

Pearson Correlations of Attentional Bias with Parents' Appraisals

	ABsub	ABsup	ABexp
Parent Appraisals of Child's			
Pain severity	.02	.06	.07
Problem-focused coping ability	.06	-.05	-.13
Emotion-focused coping ability	-.02	-.10	-.15

All correlations failed to reach statistical significance.

Indices of Vigilance and Disengagement

As mentioned previously, the significant difference between parents' response latencies to threat-neutral word pairs and neutral-neutral word pairs posed a challenge to computing meaningful indices of attentional vigilance and disengagement. The congruency index, which has been widely used as a measure of attentional vigilance (e.g., Asmundson, Carleton, et al., 2005; Asmundson & Hadjistavropoulos, 2007; Asmundson, Wright, et al., 2005), can be calculated by subtracting the mean response time for congruent threat-neutral trials (i.e., threat-neutral trials containing probed threat words) from the mean response time for neutral-neutral trials. The incongruency index, which has been widely employed to indicate difficulty disengaging from threat stimuli (e.g., Asmundson, Carleton, et al., 2005; Asmundson & Hadjistavropoulos, 2007; Asmundson, Wright, et al., 2005) is calculated by subtracting the mean response time for neutral-neutral trials from the mean response time for incongruent threat-neutral trials (i.e., threat-neutral trials containing probed neutral words). As calculated, higher congruency

index scores are proposed to indicate greater vigilance to threat words than neutral words, and higher incongruency index scores would indicate greater difficulty disengaging from threat words compared to neutral words (Koster, Crombez, Verschuere, Van Damme & Wiersema, 2006).

In the current study, parents exhibited longer response latencies to threat-neutral word pairs than to neutral-neutral word pairs. Consequently, congruency indices had negative values (M = -7.9, SD = 52.1, subliminal trials; M = -6.8, SD = 41.4, supraliminal trials) while incongruency indices had positive values (M = 3.6, SD = 51.8, subliminal trials; M = 23.6, SD = 65.6, supraliminal trials). In the current study, the value of the congruency index for supraliminally-presented words was significantly less than zero, $t(143) = -1.97$, $p = .05$, and the incongruency index for supraliminal trials was significantly greater than zero, $t(145) = 4.35$, $p < .001$. According to the manner in which the congruency index was calculated, a significant negative score may be interpreted as indicating attentional avoidance of threat-relevant stimuli (cf. Koster, Crombez, Verschuere, Van Damme et al., 2006). Positive incongruency index scores, on the other hand, have been interpreted as indicating difficulty disengaging from pain-relevant stimuli. (e.g., Asmundson, Wright, et al., 2005). Thus, the pattern of results uncovered in the current study suggests the illogical interpretation that parents exhibited both avoidance of pain-relevant stimuli and difficulty disengaging from pain-relevant stimuli. Consequently, no further analyses were computed using these indices.

CHAPTER IV

DISCUSSION

This study was the first to investigate patterns of attention toward pain-relevant stimuli in parents of pediatric patients with chronic abdominal pain (CAP) and parents of pain-free children. Based on existing research findings in healthy adults, adults with chronic pain, and patients with abdominal pain, it was hypothesized that all parents would exhibit attentional bias toward pain-relevant words compared to neutral words presented in a modified dot probe task (Hypothesis 1). It was further hypothesized that the degree of attentional bias toward pain-relevant words exhibited by parents of CAP patients would be significantly greater than the degree of attentional bias exhibited by parents of pain-free children (Hypothesis 2). Finally, the current study investigated whether attentional bias toward pain-relevant words was associated with greater bodily pain, poorer general health, higher levels of self-reported anxiety symptoms and, among parents of CAP patients, beliefs about children's pain severity and coping efficacy (Hypotheses 3 and 4).

Results of preliminary analyses of response latency data had two important implications for the analytic strategy employed in the current study. First, results showed that parents exhibited longer response latencies to threat-neutral word trials than to neutral-neutral word trials, regardless of whether word pairs were presented supraliminally or subliminally and regardless of probe or threat ("target") position. This finding suggested that computing congruency and incongruency indices from formulas

that do not correct for overarching differences in response latencies to threat-neutral and neutral-neutral trial types would yield index scores that were not readily interpretable. For this reason, indices of vigilance (i.e., the congruency index) and disengagement (i.e., the incongruency index) were not included in the primary analyses of study hypotheses. The second preliminary finding to influence the current study's analytic strategy was the significant interaction of exposure, probe position, and threat position. Follow-up analyses revealed that parents participating in the current study exhibited attentional bias toward pain-relevant words only when those threat words were presented in the lower position during trials in which probed neutral words appeared in the upper position on the screen. This finding was used to inform the calculation of an exploratory, sample-specific attentional bias index using response latencies from only those threat-neutral trials in which the threat word appeared in the lower position. Along with the widely used index of attentional bias, this exploratory index was included in all hypothesis testing.

Attentional Bias toward Pain-relevant versus Neutral Stimuli

It was expected that all parents, regardless of whether their children were CAP patients or pain-free, would exhibit attentional bias toward pain-relevant versus neutral words presented during the dot probe task. In partial support of this hypothesis, all parents exhibited attentional bias toward pain-relevant words compared to neutral words when word pairs were presented supraliminally (e.g., for 1250 milliseconds). Taking into account results of preliminary analyses revealed that attentional bias was evident specifically on supraliminal trials in which probed neutral words appeared above pain-relevant words.

The observation of attentional bias under these conditions is consistent with previously reported findings using the same dot probe paradigm. Specifically, Lipani (2007) found that children exhibited longer response latencies to supraliminal trials in which the upper position was probed compared to trials in which the lower position was probed. In contrast, other studies have reported speeded participant response to probes in the upper position of the screen (Asmundson et al., 1997; Asmundson & Hadjistavropoulos, 2007; Dehghani, et al., 2003). However, these studies are distinct from the current study and Lipani's study (2007) in that individuals were asked either to read the word appearing in the upper position aloud (Asmundson et al., 1997; Asmundson & Hadjistavropoulos, 2007) or to read the words to themselves, silently (Dehghani et al., 2003). Furthermore, these studies reporting speeded response to probes in the upper position presented word pairs for only 500 milliseconds; participants instructed to read the words may not have had time to shift from reading words in the upper position to reading those in the lower position. Participants in the current study and in Lipani's study (2007) were not specifically instructed to read the words. However, it is possible that the longer word presentation (1250 milliseconds) allowed participants time to read the word pairs from top to bottom (as they would usually read text appearing on a computer screen), resulting in attention to the lower word position when the probe appeared. Two other dot probe studies presenting word pairs for 1250 seconds did not present data regarding differential response times to probes in the upper or lower position (Boyer et al., 2006; Koster et al., 2005). Without further elaboration of the conditions under which attentional bias has been exhibited in other published studies, it is unclear whether the current finding that parents exhibited attentional bias to supraliminally-

presented threat words in the lower position when probed neutral words appeared in the upper position is consistent with the broader literature.

The current study's finding of significant attentional bias to pain-relevant stimuli presented supraliminally, but not subliminally, is consistent with Lipani's finding among CAP patients whose parents participated in the current study (Lipani, 2007). Specifically, in Lipani's study, attentional bias toward pain-related words was observed when words were presented to conscious awareness, but not when they were presented subliminally. Other studies of generally healthy adults also have found evidence for attentional bias toward supraliminal, but not subliminal, pain cues. Afzal and his colleagues (2006) reported that healthy participants in their study exhibited a significant degree of attentional bias toward IBS-symptom-relevant words presented supraliminally but not subliminally in the context of a modified Stroop task, a finding that is similar to results of the current study. Interestingly, Keogh and his colleagues found that college students with low fear of pain exhibited greater attentional bias *away* from supraliminally presented pain-relevant words, compared to subliminally-presented words (2003). Taken together, these findings suggest that consciously attended pain cues (i.e., stimuli presented supraliminally) have relatively greater impact on individuals' attention and subsequent information processing than pain cues presented outside of conscious awareness.

Alternatively, parents may exhibit differential attention to supraliminal versus subliminal pain stimuli based on the specific content of the cue. For example, a recent study found that healthy individuals and chronic pain patients exhibited attentional bias to affective pain words in the supraliminal condition, but to sensory pain words in the

subliminal condition of a modified Stroop task (Asmundson, Wright, et al., 2005). The pain-relevant words used in the current study were most similar to words used to describe the sensory (vs. affective or disability-related) aspect of pain in other investigations (e.g., Asmundson, Wright, et al., 2005; Dehghani, et al., 2003; Pearce & Morley, 1989). It is possible that parents would have exhibited different patterns of attentional bias to affect- or disability-related pain-relevant words. Parents of CAP patients express difficulty watching their children suffer (van Tilburg et al., 2006), which suggests that affective pain words (e.g., terrible, cruel, unbearable) may be particularly salient in eliciting attentional bias. The current study's finding that parents exhibited attentional bias toward pain-relevant words that generally describe sensory aspects of pain suggests the potential theoretical importance of investigating parents' attention to stimuli evoking other aspects of pain-related threat.

An additional consideration regarding the pain-relevant words employed in the current study is that the words may have lacked personal meaning for participating parents. Stronger evidence of attentional bias among parents may require using idiographic stimuli. The cognitive-affective model of chronic pain suggests that, in order to capture attention, a threat must be appraised as personally relevant (Eccleston & Crombez, 1999). A few studies have attempted to maximize the personal relevance of pain cues used in Stroop and dot probe tasks. For example, these studies have selected pain-relevant stimuli by identifying the most frequently endorsed descriptive words on a widely used measure of pain (Crombez et al., 2000) or by asking individual participants to choose words from a list to best describe their pain experiences (Andersson & Haldrup, 2003). It is possible that parents in the current study would have exhibited

stronger attentional bias to words used by their children to describe pain, or to words that they personally selected as relevant to their children's pain complaints.

The current study's failure to reveal significant attentional bias to subliminal cues among parents of CAP patients and parents of pain-free children is consistent with Lipani's (2007) finding among children whose parents participated in the current study. While Lipani (2007) and others (Keogh et al., 2003; Snider, et al., 2000) have failed to find clear evidence of attentional bias to subliminally presented pain-relevant stimuli among pain patients and healthy individuals, other studies have revealed significant biases to subliminal cues among IBS patients (Afzal et al., 2006), CAP patients (Boyer et al., 2006), adult pain patients (Asmundson, Wright, et al., 2005) and healthy adults (Asmundson, Wright, et al., 2005).

While there have been methodological differences among studies examining subliminal attentional bias, these differences do not appear to directly correspond to positive versus negative findings. For example, duration of stimuli presentation in subliminal conditions varied between approximately 14 milliseconds (Afzal et al., 2006; Asmundson, Wright, et al., 2005; Snider et al., 2000), 16.67 milliseconds (Keogh et al., 2003) and 20 milliseconds (Boyer et al., 2006; Lipani, 2007). Studies reporting positive evidence of attentional bias to subliminal stimuli used varying presentation lengths, as did studies producing no significant evidence of subliminal attentional bias. Moreover, results of awareness checks suggest that each of these presentation durations was effective in presenting stimuli outside of conscious awareness. Thus, it appears that the length of subliminal presentation is not meaningfully related to the success of failure of these studies in finding evidence of attentional bias.

A second methodological difference among studies finding varying degrees of evidence for attentional bias to subliminal stimuli is the manner in which subliminal and supraliminal trials were presented. Subliminal and supraliminal trials were randomly presented within a single trial block in two studies (Boyer et al, 2006; Lipani, 2007), while the remaining studies presented randomized blocks consisting exclusively of subliminal or supraliminal trials (Afzal et al., 2006; Asmundson, Wright, et al., 2005; Keogh et al., 2003; Snider et al., 2000). There is some evidence that exposure to supraliminal trials primes subliminal biases to threatening stimuli among healthy patients (Luecken et al., 2004). Therefore, it would be expected that exposure to blocked supraliminal trials before blocked subliminal trials would increase the extent to which study participants exhibit bias toward subliminally-presented stimuli. In fact, in the literature on attentional bias in anxiety disorders, emotional Stroop tasks employing blocked supraliminal and subliminal trials have produced larger attentional effects than emotional Stroop tasks in which supraliminal and subliminal trials presentations are fully randomized (Bar-Haim et al., 2007). Thus, one explanation for the current study's finding that parents exhibited attentional bias to pain-relevant words presented supraliminally, but not subliminally, is that presentation of supraliminal and subliminal trials in random order diminished the priming effect of supraliminal threat words. However, it is notable that, among studies examining subliminal bias to pain- and symptom-relevant words, differences in the structure of subliminal and supraliminal trials appeared not to directly correspond to significant findings. Two of the three studies reporting significant subliminal attentional bias used blocked trials (Afzal et al., 2006; Asmundson, Wright, et al., 2005), as did two of the three studies that failed to find evidence of significant

attentional bias to subliminal stimuli (Keogh et al., 2003; Snider et al., 2000). The impact of blocked versus randomized trial order may warrant further attention in future studies of pain-related attentional bias.

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Differences in Attentional Patterns Exhibited by Parents of CAP Patients and Parents of Pain-free Children

In contrast to hypotheses, parents of CAP patients and parents of pain-free children participating in the current study could not be distinguished on the basis of their attentional bias to pain-relevant stimuli. Additionally, parents with frequent abdominal pain or with symptoms of pain-related FGIDs did not exhibit greater attentional bias than symptom-free parents. These findings contradict those reported by several published studies concluding that pain patients differ from pain-free individuals in their degree of attentional bias toward pain cues (Asmundson, Wright, et al., 2005; Lipani, 2007; Roelofs, et al., 2005; Roelofs, Peters, Zeegers, et al., 2002). However, as noted previously, the literature has been characterized by contradictory findings with regard to differences in attentional bias exhibited by pain patients and healthy individuals (see Asmundson, Carleton, et al., 2005; Pincus & Morley, 2001).

The current study's failure to demonstrate differences in attentional bias to pain-relevant words among parents of pain patients and parents of pain-free children may reflect the clear situational differences between completing a "computer game" (as the dot probe task was described to participants) and interacting with a child in pain. Assessing parents' naturalistic behaviors during pain episodes associated with CAP is a challenging endeavor due to the unpredictable onset and duration of typical CAP episodes. Assessing parents' patterns of attention toward children's pain complaints

versus other environmental and internal signals would be even more difficult. Nonetheless, improvements in the ecological validity of situations in which parents' attentional bias is measured may facilitate discovery of more nuanced findings. For example, it has been shown that healthy individuals whose common-cold schema were "primed" by writing a brief narrative about their most recent cold exhibited attentional bias to common-cold-related words compared to neutral words in a modified Stroop paradigm (Henderson, Hagger & Orbell, 2007). The success of the priming condition used by Henderson and her colleagues suggests that it may be possible to structure experimental sessions so that parents are "primed" to parent-child interaction schema when they complete the dot probe task. Eliciting parent-child interaction schema prior to measuring attentional bias toward pain cues may result in identification of subgroups of parents whose information processing biases are magnified during children's pain episodes. Parents who exhibit amplified attentional bias toward pain cues in the context of parent-child interaction may subsequently engage in different behaviors in response to children's pain, compared to parents whose attentional bias toward pain-relevant stimuli is less influenced by situational features.

The current study failed to find significant differences in attentional bias toward pain-relevant words between parents who reported symptoms of pain-related FGIDs or frequent abdominal pain and pain-free parents. Eligibility for the current study did take into account parents' medical histories. It is possible that reliance on parents' responses to a single questionnaire to identify groups of parents with pain-related FGID symptoms and frequent abdominal pain resulted in grouping parents with quite diverse pain and illness histories into similar categories. Furthermore, the parents in the current study who

reported symptoms of abdominal pain-related FGIDs may have had little in common with participants in the only study, to date, of adult patients with pain-related FGIDs. Afzal and his colleagues (2006) recruited all participants from a gastroenterology clinic, where they were being treated for IBS. The current study did not collect data regarding parents' use of medical services for abdominal pain and related complaints. Therefore, it is difficult to determine the similarity of parents who reported FGID symptoms and frequent abdominal pain in the current study to adult participants in other studies of attentional bias to pain-related stimuli.

Failure to find different attentional patterns in parents with and without abdominal pain also may be attributed to the type of pain-relevant words employed in the current study. As noted previously, the pain-relevant stimuli employed in the current study were generally descriptive of sensory aspects of pain. It has been suggested that, for individuals who experience persistent pain, stimuli evoking pain's impact on functioning and self-concept may have greater salience than stimuli evoking pain, itself (see Asmundson, Carleton, et al., 2005). Two studies have examined chronic pain patients' dot probe performance in response to disability-related words (Dehghani et al., 2003, 2004). Both studies concluded that patients exhibited greater attentional bias toward sensory pain words than disability-related words. However, the direction of attentional bias exhibited by pain patients in both studies was suggestive of attentional *avoidance* of disability-related words, and the authors did not report whether patients' degree of attention away from disability-related words was statistically significant when compared to a neutral attentional stance. It is possible that assessing attentional responses to stimuli reflecting the functional impact of pain would more clearly distinguish groups of parents

with histories of abdominal pain and related symptoms from those who are symptom-free.

In considering the current study's finding that parents with frequent abdominal pain or symptoms of pain-related FGIDs did not differ from symptom-free parents, it also is important to note that the presence of pain during study participation may have influenced performance on the dot probe. Relatively little attention has been paid to whether current pain status influences performance on tasks assessing attentional bias, despite considerable evidence that current pain disrupts performance on other attentionally demanding tasks (see Eccleston & Crombez, 1999). Of two studies examining whether patients' current pain is related to performance on the modified Stroop task, one reported a significant relation between current pain and attentional bias toward pain-relevant stimuli (Crombez et al., 2000), but the other failed to find evidence of a significant relation (Pincus et al., 1998). In the current study, assessment of parents' current pain on the day of study participation would have allowed further examination of differences between groups of parents reporting frequent abdominal pain or symptoms of pain-related FGIDs and symptom-free parents. Such examination would necessarily have been exploratory in nature, as there are at least two competing theoretical perspectives on how current pain might impact attentional bias to pain-relevant stimuli. On one hand, current pain may act as a "prime" so that individuals are more attentive to pain-relevant stimuli than they would be during a pain-free period (e.g., Henderson, et al., 2007). Alternatively, current pain experiences may "override" the attentional effects observed on Stroop and dot probe tasks (Pincus & Morley, 2001), so that no attentional bias is evident.

Physical and Psychological Correlates of Attentional Bias Toward Threat

It was hypothesized that indices of parents' attention toward pain-relevant threat words would be positively correlated with self-reported symptoms of anxiety and negatively correlated with self-reported health and freedom from pain. This hypothesis was partially supported in the current study. In the total sample, in line with study hypotheses, parents with poorer general health exhibited greater attentional bias toward subliminal pain-relevant words. Among parents of pain-free children, a similar pattern emerged, as did support for the hypothesized relation between higher levels of bodily pain and greater attentional bias toward subliminally presented pain-relevant words. As previously noted, the current study did not find evidence for statistically significant subliminal attentional bias. Additionally, the exploratory attentional bias index computed only from those trials on which there was evidence of attentional bias (i.e., supraliminal trials in which threat words were presented in the lower position) was not significantly correlated with bodily pain or general health in either parents of pain-free children or in the total sample. Therefore, while these correlational findings support study hypotheses, they should be interpreted with caution.

Correlational findings among parents of CAP patients were opposite to those among parents of pain-free children and contradicted study hypotheses. Specifically, parents of CAP patients who reported the lowest levels of bodily pain and concern about their general health exhibited the highest levels of attentional bias toward supraliminally-presented pain words. The positive correlations between attentional bias, freedom from bodily pain and general health perceptions also suggest that parents who reported the highest levels of bodily pain and greatest concern about their own general health

exhibited greater avoidance of pain-relevant words presented to conscious awareness. Further consideration of the implications of these results must be qualified by the facts that supraliminal attentional bias was evident only under specific parameters (i.e., when probed neutral words appeared in the upper position in relation to threat words), and that the exploratory index of attentional bias computed to specifically examine attention to pain-relevant words under these parameters was not significantly correlated with either bodily pain or general health.

The current study's finding that higher levels of pain and health concerns were related to greater avoidance of pain-relevant stimuli among parents of CAP patients may be partially explained by the comorbidity of anxious symptomatology, bodily pain and general health among parents of CAP patients. In the current study, parents of CAP patients reported significantly higher levels of anxiety symptomatology than parents of pain-free children. Furthermore, the mean level of anxious symptomatology reported by parents of CAP patients was more similar to the mean for patients with generalized anxiety disorder than to the mean for adults without anxiety disorders (cf. Leyfer et al., 2006). These findings from the current study are consistent with findings that parents of CAP patients experience elevated symptoms of anxiety (Campo et al., 2007; Walker & Greene, 1989). As previously noted, mothers of CAP patients also are more likely to have histories of abdominal or other pain complaints than mothers of pain-free children (Campo et al., 2007; Walker et al., 1993; Wasserman et al., 1988). In light of the significant correlations of anxiety symptoms with bodily pain (r = -.35, p <.01) and general health (r = -.43, p <.01) among parents of CAP patients participating in the

current study, the potential impact of these interrelated symptoms on attentional processes warrants consideration.

In the literature concerning attentional bias in anxiety disorders, it has been suggested that anxiety is maintained by a "vigilance-avoidance" pattern such that individuals with heightened anxiety initially attend to threatening stimuli and then attempt to avoid them (see Koster et al., 2005). Koster and his colleagues (2005) found support for this proposal in their study of individuals with high levels of trait anxiety. These individuals exhibited attentional bias toward threatening pictures when they were presented for 100 milliseconds, but they exhibited attentional avoidance of threatening pictures presented for 1250 milliseconds. In the current study, word pairs were presented for 1250 milliseconds, the length at which Koster and his colleagues observed significant attentional avoidance of threatening stimuli. Others have proposed that individuals with heightened anxiety exhibit attentional avoidance of words evoking pain or general health concerns if pain and health are of current concern to them (see Mathews, 1990; Crombez et al., 2000). While the negative correlation between attentional bias to supraliminal trials and anxiety symptoms failed to reach significance, the direction of the correlation supports the idea that parents of CAP patients, who are, as a group, characterized by elevated anxiety, avoid pain-related words presented to conscious awareness. This intersection of psychological, physical, and attentional factors suggests promising directions for future studies of the factors underlying parents' responses to children's pain.

It was expected that greater attention toward pain-relevant threat words would be associated with parents' beliefs that their children's pain was severe and pain-coping

efficacy was low. Results of the current study did not support this hypothesis, as the correlations between indices of parents' attention and appraisals failed to reach statistical significance. One explanation for this finding is that parents' appraisals of pain severity and their children's coping efficacy were assessed during their children's initial visit to the gastroenterology clinic, not at the time of study participation. The amount of time that elapsed between patients' initial clinic visits and their participation in the current study ranged from five days to sixteen months. While eligibility criteria excluded children who were no longer experiencing abdominal pain from participating in the current study, it is quite plausible that the nature of children's pain complaints or coping efficacy may have changed between their initial clinic appointment and their participation in the current study. For example, children's pain may have become more or less frequent, or some children may have undergone intervention that influenced the manner in which they cope with pain. Changes in children's pain complaints and coping may in turn have contributed to changes in parents' beliefs. In addition, parents' beliefs may have been directly influenced by encounters with the gastroenterologist during their children's initial clinic visit or by subsequent interventions. According to Lazarus and Folkman's model of appraisal and coping (1984), appraisals, by their very nature, reflect individuals' current concerns. It is possible that parents' appraisals of their children's pain severity and coping efficacy assessed at the time of dot probe completion would have been significantly associated with their patterns of attention to pain-relevant threat.

Indices of Vigilance and Difficulty Disengaging

Examination of attentional vigilance and disengagement is a relatively new development in research on pain-related biases (see Koster et al., 2004). Differentiation of vigilance to pain-related threat and difficulty disengaging may facilitate more effective treatments for chronic pain patients (e.g., Asmundson, Wright, et al., 2005; Koster et al., 2004) and, of particular interest to the current study, may inform further investigations of links between attentional patterns and responses to pain. For these reasons, it is believed that the distinction between vigilance and disengagement warrants empiric attention. However, the current study's findings suggest that the analytic strategies used to examine vigilance and disengagement may vary in their utility.

The current study's finding of a significant difference in response latencies to threat-neutral compared to neutral-neutral trials provided a challenge to meaningful interpretation of continuous indices of vigilance and disengagement as they have been calculated in the published literature on pain-related attentional bias (Asmundson, Carleton, et al., 2005; Asmundson & Hadjistavropoulos, 2007; Asmundson, Wright, et al., 2005; Roelofs et al., 2005). Specifically, interpretation of the current study's continuous indices of vigilance and disengagement would yield the illogical conclusion that parents exhibited both avoidance of threatening stimuli and difficulty disengaging from threatening stimuli on the same experimental task. These findings suggest that calculation of continuous indices of vigilance and disengagement may be problematic when there is a main effect of dot probe trial type, such that individuals exhibit significantly different response latencies to experimental (i.e., threat-neutral) and control (i.e., neutral-neutral) trials.

In studies published to date, continuous indices of attentional vigilance toward or disengagement from pain-related stimuli have been employed without prior examination of significant differences in response latencies to threat-neutral and neutral-neutral trial types (Asmundson, Carleton, et al., 2005; Asmundson & Hadjistavropoulos, 2007; Asmundson, Wright, et al., 2005). In fact, most dot probe studies of pain-related bias have not reported whether response latencies to experimental and neutral trials differ. In some cases, this is because the dot probe tasks have not included neutral-neutral trials (Boston & Sharpe, 2005; Dehghani et al., 2003, 2004; Keogh et al, 2003). Other studies have included neutral-neutral trials but have not compared raw response latencies on these trials with raw response latencies on threat-neutral trials (Asmundson & Hadjistavropoulos, 2007; Asmundson et al., 1997; Asmundson, Wright, et al., 2005; Boyer et al., 2006; Keogh et al., 2001; Lipani, 2007). The tendency to overlook significant differences in response latencies to experimental versus neutral trials may have had little, if any, impact on analyses using the straightforward attentional bias index. The most widely used attentional bias index in the literature is calculated from response times to threat-neutral trials only, so the index score is unaffected by significantly longer response latencies to experimental or neutral trials. Now that neutral-neutral trials are being included in analyses of attentional effects, the potential impact of overlooking significant differences in response latencies must be addressed.

Several studies have examined vigilance and disengagement effects without calculating continuous index scores. For example, in the literature on anxiety-related attentional bias, attentional vigilance and disengagement have been identified by analyses directly comparing response latencies on threat-neutral trials to response latencies on

neutral-neutral trials (Koster, et al., 2004; Koster, Crombez, Verscheure & de Houwer, 2006; Koster et al., 2005; Salemink et al., 2007). To date, this strategy also has been used in a single study of pain-related attentional bias (Roelofs et al., 2005). Using this analytic strategy, attentional vigilance is indicated by speeded responses to congruent threat-neutral trials (in which the threat word is probed) compared to neutral-neutral trials. Disengagement, on the other hand, is indicated by speeded response to neutral-neutral trials, compared to incongruent threat-neutral trials (in which the neutral word is probed). It is notable that these studies did not report whether response times to all threat-neutral trials, including both incongruent and congruent trials, differed from response times to neutral-neutral trials.

Directly comparing response latencies to experimental and control trials circumvents the problematic interpretation of continuous indices when significant differences in experimental and control trial response latencies are evident. However, a significant effect of word type (threat-neutral versus neutral-neutral) on this analytic strategy may also be problematic. In the current study, the significant main effect of word type (i.e., the significant difference between response latencies to threat-neutral and neutral-neutral trial types) was not qualified by any higher-order interactions. Therefore, comparing response latencies for congruent or incongruent experimental trials to response latencies to neutral-neutral trials was considered unwarranted.

The current study's findings suggest a call for clearer parameters around the appropriate use of continuous indices of attentional vigilance and disengagement. Most dot probe studies of pain-related attentional bias do not report analyses exploring significant differences between response latencies to experimental and neutral trials.

However, as evident in the current study's findings, significant differences in response latencies to experimental and neutral trials can pose problems for meaningfully interpreting subsequent analyses. In particular, baseline differences in response latencies to experimental and neutral trials pose problems for the computation of continuous indices of vigilance and disengagement. Development of consistent and reliable standards for analyzing vigilance and disengagement effects will be of considerable use to further investigations of pain-related attentional bias.

Study Limitations and Directions for Future Research

As the first study to examine attentional bias in parents and compare attentional patterns exhibited by parents of CAP patients and parents of pain-free children, the current study contributes to the growing literature addressing complex features of parent-child interaction in pediatric chronic pain. Nonetheless, it is important to recognize that methodological limitations may have influenced the nature of the current study's findings. The current study utilized a dot probe paradigm designed to directly assess attentional bias (MacLeod et al., 1986). Dot probe tasks have become widely used in literatures concerning numerous clinical problems, including chronic pain and, of particular relevance to the current study, abdominal pain. As an alternative to the modified Stroop task, the dot probe reflects a more "pure" measure of attentional processing (see MacLeod et al., 1986). However, use of the dot probe has produced contradictory findings not only in the study of pain-related attentional biases, but also in the study of anxiety-related biases, prompting the suggestion that the dot probe task is "relatively fragile" to attentional bias effects in non-clinical samples (Mogg et al., 2000).

The current study reported evidence of significant attentional bias toward pain-relevant threat words, but only in the context of supraliminal trials in which threat words were presented in the lower position and probed neutral words appeared in the upper position. Replication of the dot probe task or other attentional bias tasks (e.g., emotional spatial cueing or visual search paradigms; see Bar-Haim et al., 2007) among parents of CAP patients and parents of pain-free children may clarify whether the limited nature of this finding accurately reflects parents' attentional processes, underlying "fragility" of the dot probe paradigm, or some combination of these and other effects.

A methodological strength of the current study is the rigorous process through which the list of pain-relevant and neutral words was developed. Potential pain-relevant and neutral words were screened by teachers for readability at the third grade level, categorized (e.g., as "physical threat" versus "social threat") by graduate students in psychology, and rated by students between the ages of 8 and 15 years according to their positive, neutral or negative valence. These methods produced a list of physical and social threat words and neutral words that would be suitable for use in the study of attentional bias among pediatric CAP patients and pain-free youth. In the current study, parents of participating pediatric patients and pain-free youth completed the same dot probe task as their children. Thus, the words deemed to be sufficiently readable, category-relevant and having appropriate threat or neutral value for children over the age of eight years were administered as pain-relevant and neutral stimuli to adult study participants. There are advantages to this design: attentional bias scores attained by parents and their children are directly comparable, and it is reasonable to assume that parents with basic (i.e., third grade level) literacy skills are able to participate fully in the

study. Additionally, the included words, which were readable and understandable to children as young as eight years of age, may be more similar to the language of children's pain complaints than pain-relevant stimuli typically used in studies with adults (e.g., gnawing, pulsating). In this respect, using words rated as threatening by children and adolescents may have increased the ecological validity of the current study's assessment of parents' responses to children's pain cues.

The primary disadvantage of administering a word list generated for children and adolescents to their parents is that the pain-relevant words may not have had sufficient threat value to elicit attentional bias in adults. The current study did not assess whether parents found dot probe words to be threatening, and it is possible that parents and children would assign different levels of threat to words such as "hurt" and "throwup". To date, published studies of pain-related attentional bias have not directly examined whether differing degrees of threat result in distinct attentional patterns. However, findings that chronic pain patients exhibit different attentional patterns toward pain-relevant words representing different aspects of pain (e.g., sensory or affective components, or disability) illustrate that there is variability in the extent to which pain-related stimuli elicit attentional bias (e.g., Dehghani et al., 2003, 2004). Furthermore, in dot probe studies of anxiety-related attentional bias, healthy adults have exhibited different attentional responses to pictorial stimuli categorized as having either "high" or "moderate" threat value (Koster et al., 2004; Koster et al., 2005; Koster, Crombez, Verschuere & de Houwer, 2006). Thus, in the current study, the perceived threat value of dot probe stimuli may have impacted the degree of attentional bias parents exhibited. It follows that assessing the threat value of word stimuli may be an important component of

future dot probe research examining pain-related attentional biases in parents of CAP patients.

In addition to addressing limitations of the current study, future research efforts incorporating previously mentioned issues will clarify of the nature of pain-related attentional bias in parents. Our ability to fully describe parental attentional bias will improve when future studies examine differential attention toward stimuli reflecting distinct aspects of pain, including those aspects of particular salience to parents. Assessing parents' pain and appraisals of children's pain severity and coping ability in the same time frame as their attentional bias is being assessed, and examining the interactions between anxiety, pain, health concern and attention also may contribute to a more full understanding of parents' attentional bias to pain. In addition, it is anticipated that we will gain a better understanding of parents' attentional bias toward children's pain cues by designing studies to prime parent-child interaction schemas immediately prior to assessment of attention. Finally, our ability to differentiate attentional vigilance and disengagement will be advanced by future dot-probe research in which the presentation duration of pain-relevant stimuli is varied and by continued pursuit of reliable and valid analytic strategies for assessing these important subcomponents of attentional bias.

Future research examining parental pain-related attentional bias in subgroups of CAP patients may be particularly fruitful. As CAP is increasingly recognized as a symptom associated with heterogeneous underlying etiologies and various patterns of psychosocial adaptation, attention to variability in the family factors impacting patients' adaptation to CAP can be expected to grow. To date, subgroups of CAP patients have been identified on the basis of symptom-based criteria for functional gastrointestinal

disorders (e.g., Baber et al., in press; Robins, Glutting, et al., 2005; Walker et al., 2004), patterns of adaptation to chronic pain (Scharff et al., 2005), and patterns of coping with pain (Walker, Baber, Garber & Smith, in press). Studies examining the influence of parent-child interaction on adaptation to chronic pain may consider investigating whether specific constellations of parent characteristics, including attentional bias, anxiety, and pain, are associated with unique parental responses to children's pain and, ultimately, to subgroup characteristics.

Conclusions and Clinical Implications

The purpose of the current study was to examine attentional bias to pain-related stimuli among parents of CAP patients and parents of pain-free children. This investigation was prompted by the observation that, while research suggests that parents' responses to children's pain influence children's distress and adaptive responding to pain, very little is known about factors influencing parents' naturally-occurring responses during children's pain episodes. In light of research suggesting biased attentional processing of threatening material in individuals with numerous clinical conditions, including chronic pain and abdominal pain, it was hypothesized that parents of CAP patients would exhibit greater attentional bias toward pain-relevant stimuli than would parents of pain-free children. Additionally, it was hypothesized that parents' own experiences of bodily pain, health concerns and anxiety would be related to the degree of attentional bias exhibited upon performance of a dot probe task.

The current study's finding of attentional bias toward supraliminally-presented pain stimuli under specific presentation conditions may be interpreted as preliminary

support for attentional bias to pain stimuli among parents. It is noteworthy that the current study failed to find differences in attentional patterns exhibited by parents of CAP patients and parents of pain-free children. Additionally, parents' own reports of abdominal pain or pain-related FGID symptoms were not sources of variability in attention to pain-related words. These findings, which contradicted study hypotheses, warrant an attempt at replication. In fact, the mixed findings of the present study suggest myriad directions for future research.

If future research succeeds in replicating and extending the current study's findings, it will remain to be seen whether parents' attention to pain predicts their responses to children's pain episodes. Application of the cognitive-affective model of chronic pain (Eccleston & Crombez, 1999) to pediatric pain predicts that parents who are biased to attend to children's pain cues may engage in behaviors intended to facilitate escape from pain. Whether parents' reassuring or solicitous behaviors toward their children are believed to facilitate escape or relief from pain is an empirical question that has not yet been addressed. However, if it is shown that parents who exhibit greater attentional bias to pain also exhibit solicitous behavior in response to children's pain, then attention to pain may be a worthwhile target of intervention.

Attentional bias may be amenable to change via cognitive-behavioral techniques that challenge maladaptive negative assumptions and thoughts (Mobini & Grant, 2007). To date, changes in attentional bias have been viewed primarily as an indirect effect of intervention. For example, a preliminary study of adult chronic pain patients reported that an intensive CBT intervention resulted in decreased attentional bias toward sensory pain words in a dot probe (Dehghani et al., 2004). In line with this research, parents'

attentional bias to pain may eventually be measured prior to and following family-based CBT interventions for CAP that focus, among other things, on restructuring parents' responses to children's pain complaints. Interventions producing lasting reductions in parents' attentional bias to pain-related cues may also produce lasting changes in parents' responses to pain. Changes in parents' responses to pain may, in turn, contribute to reduced functional disability among CAP patients. As the medical community increasingly emphasizes return to usual functioning as the primary goal of CAP treatment (DiLorenzo et al., 2005a), effective interventions that encourage children and families to maintain usual functioning will be increasingly valued. Of greatest importance, interventions that succeed in reducing functional impairment during pain episodes may improve the long-term developmental and psychosocial outcomes for pediatric CAP patients.

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