PREDICTORS OF COPING SUCCESS IN CHILDREN WITH FUNCTIONAL ABDOMINAL PAIN: THE INFLUENCE OF EXECUTIVE FUNCTION AND ATTENTION REGULATION

by

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ABSTRACT

Theoretical models of adjustment to chronic illness underscore the influence of executive function and attention regulation in children's coping attempts, yet few studies have investigated the relations between these neurocognitive variables, coping and adjustment. This study examined the role of executive function and attention regulation in coping and its effect on pain and functional disability in 44 children and adolescents with functional abdominal pain. Participants and their caregivers completed measures of executive function, attention regulation, coping, and several outcome variables including pain, functional disability, and anxiety. Results revealed significant relations between selective attention abilities and two different approaches to coping with the stressor of abdominal pain episodes. Executive function and attention regulation did not directly or indirectly affect levels of pain or functional disability. Support was found for the indirect effects of selective attention on anxiety through cognitive coping strategies. This study highlights the role of neurocognitive variables in coping and provides a framework for future research.

LIST OF ABBREVIATIONS AND SYMBOLS

ADHD	Attention-deficit hyperactivity disorder
ALL	Acute lymphocytic leukemia
API	Abdominal Pain Index
BASC-2	Behavioral Assessment System for Children-Second Edition
BRI	Behavioral Regulation Index
BRIEF	Behavior Rating Inventory of Executive Function
CBCL	Child Behavior Checklist
EF	Executive function
F	Fisher's *F* ratio
f^2	Cohen's effect size
FAP	Functional abdominal pain
FAPS	Functional abdominal pain syndrome
FDI	Functional Disability Inventory
GEC	Global Executive Composite
M	Mean
MASC	Multidimensional Anxiety Scale for Children
MASC-10	Multidimensional Anxiety Scale for Children – 10-item form
MCI	Metacognition Index
MFFT	Matching Familiar Figures Test
p	Probability associated with the occurrence under the null hypothesis of a

	value as extreme as or more extreme than the observed value
PCS-C	Pain Catastrophizing Scale for Children
PRS	Parent Rating Scale
PTG	Posttraumatic growth
r	Pearson product-moment correlation
R^2	Multiple correlation squared
RAP	Recurrent abdominal pain
RSQ	Responses to Stress Questionnaire
SD	Standard deviation
t	Computed value of *t* test
T	Standardized score compared to measure norms
TEA	Test of Everyday Attention
TEA-Ch	Test of Everyday Attention for Children
WISC-III	Wechsler Intelligence Scale for Children, Third Edition
$<$	Less than
$>$	Greater than
=	Equal to

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CHAPTER 1

INTRODUCTION

Complaints of pain are a frequent concern for patients referred to a physician for medical care. In children and adolescents, abdominal pain represents the most common recurrent pain complaint (McGrath, 1990) and is a frequent reason for the utilization of health care services (Campo, Jansen-McWilliams, Comer, & Kelleher, 1999). Long-lasting constant or intermittent abdominal pain, termed chronic abdominal pain (American Academy of Pediatrics and North American Society for Pediatric Gastroenterology, Hepatology, and Nutrition, 2005) is a widespread problem affecting approximately 10-15% of school-age children and approximately 20% of adolescents (Faull & Nocol, 1986; Hyams, Burke, Davis, Rzepski, & Andrulonis, 1996; Zuckerman, Stevenson, & Bailey, 1987). Chronic abdominal pain affects children's lives by limiting their participation in everyday activities and leading to increased costs associated with frequent health care utilization (Bury, 1987; Robinson, Alverez, & Dodge, 1990; Kaufman et al., 1997). Typically functional in nature, the majority of chronic abdominal pain cases do not have an identifiable disease process (Boyle, 1997). Most studies report that only 5-10% of children with chronic abdominal pain have an organic basis for their pain (Apley, 1975; Stickler & Murphy, 1979).

In addition to recurring episodes of pain, chronic abdominal pain affects children's lives by limiting their participation in everyday activities and leading to increased costs associated with frequent health care utilization. Children with chronic abdominal pain often miss a considerable amount of school (Bury, 1987; Robinson, Alverez, & Dodge, 1990) and they experience disturbances in social relations and activities (Feuerstein & Dobkin, 1990). There are also significant financial costs associated with chronic abdominal pain in terms of primary care visits, hospital stays and diagnostic tests (Coleman & Levine, 1986; Kaufman et al., 1997).

Traditionally referred to as recurrent abdominal pain (RAP) by researchers and clinicians, chronic abdominal pain has been defined as at least three episodes of abdominal pain within a 3-month period that are severe enough to interfere with daily activities (American Academy of Pediatrics and North American Society for Pediatric Gastroenterology, Hepatology, and Nutrition, 2005; Apley, 1975; Apley & Naish, 1958). Due to the ambiguity of the original criteria for RAP and the heterogeneity of the populations diagnosed as having it under the criteria (i.e., organic vs. nonorganic), researchers have advocated using more specific criteria and diagnostic categories of chronic abdominal pain. The Rome Working group (Rasquin et al., 2006; Rasquin-Weber et al., 1999) proposed a classification system that excluded RAP as a diagnostic entity and focused on differentiating functional gastrointestinal disorders. They delineated four categories of abdominal pain, including functional dyspepsia, irritable bowel syndrome, abdominal migraine, and functional abdominal pain (FAP), and proposed specific criteria for each. Since the majority of previous research on childhood abdominal pain did not make distinctions between diagnostic categories of abdominal pain and used RAP as a term that encompasses all categories, the following review will use RAP to indicate chronic abdominal pain in general and not a specific category, unless otherwise specified.

The biopsychosocial model provides a framework for understanding the biological and psychosocial mechanisms implicated in the development and maintenance of chronic pain, in general, and FAP, in particular. Recent evidence in adults supports the hypothesis that alterations in the central and enteric (digestive) nervous systems contribute to the development of visceral hyperalgesia, or increased sensitivity, and the symptoms of chronic pain seen in FAP (American Academy of Pediatrics and North American Society for Pediatric Gastroenterology, Hepatology, and Nutrition, 2005; Hyams & Hyman, 1998). Specific biological processes associated with FAP include changes to sensory receptors in the intestine, as well as modifications of sensory transmissions in the central and peripheral nervous systems, cortical perceptions, and memories of pain sensations (Hyams & Hyman, 1998).

Several psychological factors have been implicated in the development and maintenance of RAP, including environmental and familial factors, heightened levels of perceived stress, and inadequate coping. Investigators have proposed a number of environmental and family factors that may influence RAP symptoms of pain and other somatic complaints. The social learning perspective of pain may partly explain children's experiences with recurrent pain (Craig, 1980). Studies have shown that parents of children with RAP score higher on measures of hypochondriasis and somatization than parents of nonmedical controls (Robinson et al., 1990; Walker & Greene, 1989). Walker et al. (1991) reported that higher levels of parental somatization were associated with higher levels of somatization in children with RAP, but not in children with an organic basis for their pain. In a 1-year follow-up of children with RAP, those children whose fathers had more somatic complaints at baseline had more somatic complaints at follow-up (Walker et al., 1994).

Along with providing models of illness behavior, parents may also directly or indirectly encourage symptoms and illness behavior in their children through operant conditioning principles. One study showed that, in general, parents encourage children to engage in illness behavior more for gastrointestinal symptoms than for other illness symptoms (Walker & Zeman, 1992). Compared to parents of healthy controls and psychiatric controls, parents of children with

RAP respond more favorably to complaints of abdominal pain (Walker et al., 1993), likely reinforcing such pain complaints.

Other psychosocial variables, including depression and attention problems, have been associated with RAP. Though considered to be of importance in RAP, the evidence related to depression is equivocal. Garber et al. (1990) found higher levels of depression in children with RAP in comparison to healthy controls, but other researchers have failed to find significant differences (Hodges, Kline, Barbero, & Flanery, 1985; Walker & Greene, 1989). Although children with RAP may not have elevated levels of depression, research has shown that higher levels of self-efficacy are associated with fewer symptoms of depression (Kaminsky, Robertson, & Dewey, 2006), suggesting the importance of children's confidence in their ability to cope. There is also evidence that suggests problems with attention. One study showed that, when compared to norms on a parent-rated behavior inventory, children with RAP have elevated levels of attention difficulties (Robins, Schoff, Glutting, & Abelkop, 2003).

Elevated levels of anxiety also have been implicated in children with RAP. A number of studies show that children with RAP have higher levels of generalized anxiety symptoms and somatic symptoms than healthy controls (Dorn et al., 2003; Garber, Zeman, & Walker, 1990; Hodges, Kline, Barbero, & Woodruff, 1985; Walker & Greene, 1989; Walker, Garber, & Greene, 1993). Walker and colleagues' studies (Walker & Greene, 1989; Walker, Garber, & Greene, 1993) revealed that children with RAP have similar levels of anxiety symptoms and somatic complaints as children with organic abdominal pain. This suggests that higher levels of anxiety may not differentiate children with organic or functional pain and that increased anxiety may be related to the presence of abdominal pain in general (Scharff, 1997).

Researchers have speculated on the relation between psychosocial stressors and episodes of abdominal pain in children with RAP. While cross-sectional studies have found no differences in the amount of negative life events between children with RAP and other patient groups (Walker, Garber, & Greene, 1993; Walker & Greene, 1991), prospective studies reveal that the maintenance of RAP symptoms after a medical appointment is predicted by negative family life events (Walker, Garber, & Greene, 1994; Walker & Greene, 1991). One study comparing children with RAP and healthy controls using a daily-diary method found that children with RAP reported more everyday stressors than healthy controls (Walker, Garber, Smith, Van Slyke, & Claar, 2001). Future research using daily assessments of everyday stressors comparing children with functional pain and organic pain is needed to control for the presence of pain as a stressor.

In addition to the level of perceived stress, studies have explored how children with RAP handle stressors. The Walker et al (2001) finding is notable because they reported that the association between daily stressors and somatic symptoms was stronger for the RAP group than for the healthy control group. A potential reason for this finding may be appraisal of stress. Another study using a daily diary method found that children with chronic abdominal pain appraised their ability to change or adjust to daily stressors as lower than healthy controls (Walker, Smith, Garber, & Claar, 2007). Children's appraisals of their ability to either change or adjust to the situation were related to levels of pain, somatic symptoms, and symptoms of depression. Walker et al. (1994) reported that the impact of negative life events on RAP symptoms was moderated by children's self-rated social competence. Children who reported high levels of negative life events reported more RAP symptoms when they rated themselves low in social competence, suggesting that individual differences in coping may influence the presentation of symptoms in children with RAP (Janicke & Finney, 1999).

Coping with Functional Abdominal Pain

The Disability-Stress-Coping Model. The disability-stress-coping model (Wallander & Varni, 1992) of adjustment to chronic illness, depicted in Figure 1, proposes that the relation between both psychosocial and illness-related stress and adjustment is moderated by the child's stress processing or coping. The model also suggests that intrapersonal characteristics of the child, such as temperament and competence, affect the way a child copes, the level of stress experienced, and the overall adjustment of the child. Although not specifically noted in the model (Wallander & Varni, 1992), executive function and attention regulation are intrapersonal characteristics that may influence the effectiveness of coping and one's adjustment to stress. Executive function and attention regulation are closely related to effortful control, which is a specific aspect of temperament (Rothbart & Bates, 1998). This project examined the role of executive function and attention regulation in coping with the stressor of FAP.

Voluntary and Involuntary Stress Responses. Compas and colleagues (Compas, Connor-Smith, Saltzman, Thomsen, & Wadsworth, 2001) proposed a multidimensional model for understanding reactions to stress, involving both voluntary and involuntary responses. Coping responses are the voluntary responses intended to alter cognitions, emotions, behavior, bodily processes, and the environment in response to stress. These voluntary responses are categorized further into primary control engagement coping, secondary control engagement coping, and disengagement coping; confirmatory factor analyses support the division of voluntary coping attempts into these three categories (Compas et al., 2006; Connor-Smith, Compas, Wadsworth, Thomsen, & Saltzman, 2000). Primary control engagement coping involves attempts to alter one's emotions or the stressor itself and includes such things as problem solving and emotional modulation (Compas et al., 2006; Connor-Smith et al, 2000). Secondary control engagement coping includes efforts to become accustomed to the stressor by modifying cognitions or regulating attention and includes strategies like positive thinking and cognitive restructuring (Compas et al., 2006; Connor-Smith et al, 2000). Disengagement coping involves disengaging from the stressor or from one's emotions related to the stressor and consists of things like denial, wishful thinking, and distraction (Compas et al., 2006; Connor-Smith et al, 2000).

Involuntary stress responses are the conditioned and temperamentally based reactions to stressors and are separated into two categories: involuntary engagement and involuntary disengagement. Involuntary engagement includes such things as physiological and emotional arousal, intrusive thoughts, and rumination (Connor-Smith et al, 2000). Inaction, cognitive interference, and emotional numbing comprise some of the reactions in involuntary disengagement (Connor-Smith et al., 2000). This project focused on only the voluntary stress responses of children with FAP.

Components of the limbic system and the amygdala, in particular, are thought to direct involuntary stress responses, while the prefrontal cerebral cortex is hypothesized to control the more sophisticated voluntary responses (for review, see Compas & Boyer, 2001). The development and use of involuntary and voluntary stress responses generally mirrors children's development of the prefrontal cerebral cortex and related executive functions (Compas & Boyer, 2001). Infants appear to have involuntary stress responses early in life, such as self-soothing behaviors (Gunnar, 1994), while the use of voluntary stress responses seem to develop during early childhood and correspond with the development of the prefrontal cortex and more complex language abilities (Compas & Boyer, 2001). The continued development of the prefrontal cortex, as well as mental representation and language abilities, throughout childhood allows for more complex planning and evaluation of potential choices and actions, both of which are necessary for voluntary responses to stress (Compas & Boyer, 2001).

Investigations into the stress responses of children with RAP have found that disengagement coping strategies (e.g., denial, inaction, wishful thinking) are associated with increased levels of pain, somatic symptoms, anxiety and depression, while engagement coping strategies (e.g., problem solving, cognitive restructuring, positive thinking) are associated with fewer symptoms (Compas et al., 2006; Kaminsky et al., 2006; Thomsen et al., 2002; Walker, Smith, Garber, & Van Slyke, 1997). These findings demonstrate that children with RAP who apply attention-demanding engagement responses to cope with the frequent episodes of pain appear to have better outcomes.

Role of Executive Function and Attention in Coping with Functional Abdominal Pain. Executive function (EF) is conceptualized as a dynamic, multidimensional collection of self-regulatory processes that select, guide, and manage behavioral, emotional and cognitive activity (Gioia, Isquith, Guy, & Kenworthy, 2000). Crucial elements of EF include initiation, planning, inhibition, organization, as well as many elements of attention regulation such as shifting of attention and sustaining attention (Mahone et al., 2002). EF and attention regulation are of particular importance during problem solving in novel situations where the tasks required are not performed regularly (Gioia et al., 2000; Mahone et al., 2002). Once these novel tasks become routine, the demand on attention and EF decreases and these processes become automatic (Compas et al., 2001).

Similar to coping responses, children's EF and attention regulation are largely guided by the prefrontal cortex, as well as the posterior parietal cortex (Casey et al., 2004; Compas &

Boyer, 2001). As children develop, they show more efficient abilities to control and switch their attention to competing stimuli, which is likely due to the continued development of the prefrontal cortex. Posner's developmental-biological model of attention (Posner & DiGirolamo, 1998) proposes that the posterior attentional system controls the ability to shift attention and is distributed across the midbrain, thalamus, and parietal cortex. The model also suggests that the anterior attentional system, which is located in the frontal cortex, is responsible for higher-order executive functions, such as sustained attention, effortful control, and inhibition of dominant responses. An MRI study demonstrated the importance of posterior parietal areas and their connections to subcortical regions (the caudate nucleus of the striatum) during a non-cued attention-switching task regardless of age, but participants showed increasing reliance on frontal cortical regions with age (Casey et al., 2004).

Empirical studies on the development of attention regulation and EF in children suggest that these abilities mature in a non-linear fashion, and likely mirrors children's development of coping responses. Studies investigating the development of sustained attention generally find the greatest improvements in early-to-middle childhood, more gradual changes occurring in later childhood, and a plateau during adolescence (e.g., Betts, McKay, Maruff, & Anderson, 2006; Greenberg & Waldman, 1993; Klimkeit, Mattingley, Sheppard, Farrow, & Bradshaw, 2004; Rebok et al., 1997; Welsh, Pennington, & Groisser, 1991). For example, a longitudinal study using the continuous performance paradigm found that the most rapid changes improvements occurred between age 8 and 10, with gradual improvements between 10 and 13 years of age (Rebok et al., 1997). Another study using a novel selective reaching task found similar patterns in the development of vigilance, set shifting, and response inhibition in children ages 7 to 12 (Klimkeit et al., 2004). A study of 400 children between the ages of 3 and 12, found that the development of several components of EF proceeded in sequence, with impulse control maturing first around age 6, followed by selective and sustained attention maturing around age 10 (Klenberg, Korkman, & Lahti-Nuuttila, 2001).

As part of a more global biopsychosocial model of chronic illness (see Figure 2), Compas proposed that the association between coping with stressors and psychosocial adjustment is largely influenced by higher order executive functions, such as attention regulation, working memory, and inhibition (Compas, 2006; Compas & Boyer, 2001). The model suggests that stressors trigger either involuntary or voluntary stress responses and that self-regulatory processes not only influence children's appraisal of potential stressors but also the choice and effectiveness of the voluntary stress response (Compas, 2006; Compas & Boyer, 2001). Attention regulation and self-monitoring abilities are required to detect and continuously appraise potential stressors, shift attention, and focus attention to employ various coping responses.

Executive processes likely serve important functions during coping attempts and breakdowns in the interaction between these processes and coping during periods of stress can result in ineffective coping. First, cognitive flexibility is required to shift the allocation of cognitive resources from the stressor to an active coping attempt. Children who have difficulty shifting their attention from distressing stimuli in order to engage in a coping response may be at increased risk for poor outcomes (Compas & Boyer, 2001). In children with chronic abdominal pain, poor ability to regulate attention during pain episodes may lead to increased focus on the pain, increased pain-related anxiety, increased sensations of pain (Walker, 1999), and increased rates of functional disability. A study examining the coping responses of children with various levels of abdominal pain partially supports this hypothesis (Walker et al., 1997). Results showed that children who attended more to the pain had increased rates of pain and somatic complaints. This suggests that difficulties shifting attention away from physical pain increase the likelihood of adjustment problems.

Second, attention regulation and EF may influence the choice of coping strategy. Individuals with limited executive capacities and those who are not able to control their attention are more likely to adopt avoidance or disengagement strategies (Matthews, Coyle, & Craig, 1990), and thus may be more likely to develop adjustment difficulties. In a sample of 30 adolescent survivors of childhood acute lymphocytic leukemia (ALL), Campbell et al. (2009) found that components of EF, such as working memory, inhibition, and cognitive flexibility, were related to the type of coping employed. Better EF abilities were related to the use of primary control engagement and secondary control engagement coping, while poorer EF was related to increased use of disengagement coping strategies.

EF and attention regulation also may indirectly affect outcomes by influencing the effectiveness of coping strategies (Compas & Boyer, 2001). Voluntary engagement coping strategies, which are associated with better outcomes (Thomsen et al., 2002; Walker et al., 1997), most likely demand greater executive resources and require more focused attention than disengagement responses. Children who have difficulty mentally manipulating information, resisting distraction, and focusing and sustaining their attention when faced with a stressor may not be able to effectively implement more active coping strategies, such as cognitive restructuring, that require greater attentional focus (Matthews & Wells, 1996). In children with chronic abdominal pain, these inefficient coping attempts may increase the risk for poor adjustment and lead to higher rates of pain and functional disability. In their study with 30 ALL survivors, Campbell et al. (2009) examined the indirect influences of EF on behavior problems through coping. They found that secondary control engagement coping mediated the relations between working memory, cognitive flexibility, and self-monitoring and behavior problems. This finding suggests that better EF abilities is related to the use of adaptive coping strategies, which in turn is related to better behavioral outcomes.

Present Study

No studies have explicitly explored the influence of EF and attention regulation on voluntary stress responses in children with a chronic pain condition such as FAP. Conceptual models of adjustment to chronic illness (Compas & Boyer, 2001; Wallander & Varni, 1992) suggest that EF and attention regulation indirectly influence children's adjustment through coping; EF and attention regulation affect the effectiveness of the coping attempt, which influences the child's adjustment. Clarifying the role of EF and attention regulation in coping would contribute to the growing literature on the factors underlying the varying outcomes associated with FAP. Identifying the individual differences within children with FAP and the factors associated with various outcomes, allows for early, targeted intervention in those children with FAP who are most at risk for poorer outcomes. Previous research within chronic abdominal pain samples has found individual differences in coping responses that predict worse outcomes, including increased pain, functional disability, and anxiety (Compas et al., 2006; Kaminsky et al., 2006; Thomsen et al., 2002; Walker et al, 1997). The purpose of this study was to examine the indirect effects of EF and attention regulation on pain and functional disability through coping in children with FAP.

Primary Aims and Hypotheses

The current study addressed the following aims and hypotheses regarding the relations between EF, attention regulation, coping, and pain and functional disability: 1) the choice of coping strategies will be related to EF and attention regulation. Poorer EF and attention regulation will be associated with employing more disengagement coping strategies and fewer engagement strategies. 2) Measures of EF and attention regulation will be significant predictors of pain and functional disability while controlling for appropriate variables. 3) EF and attention regulation will have significant indirect effects on pain and functional disability through voluntary engagement coping responses (see Figure 3).

Secondary Aims and Hypotheses

In order to replicate and expand on previous findings regarding children's coping responses and psychological outcomes (Compas et al., 2006; Kaminsky et al., 2006; Thomsen et al., 2002; Walker et al., 1997), the relations between the type of coping responses used and symptoms of depression and anxiety were explored. Previous investigations into the relation between coping and psychological adjustment have relied mainly on parent-reports of coping (e.g., Thomsen et al., 2002; Walker et al., 1997), while this study used self-reports of coping. It is expected that increased use of engagement strategies will be related to fewer symptoms.

Although generally accepted as a predictor of increased levels of pain, anxiety, and other somatic complaints in adults, there are only two published studies on the influence of pain catastrophizing in children (Crombez et al., 2003; Vervoort et al., 2006). A final hypothesis is that pain catastrophizing will be significantly related to pain, functional disability, and anxiety.

CHAPTER 2

METHODOLOGY

Participants

The sample consisted of 44 school-aged children (age 8-16), diagnosed with functional abdominal pain and one of their caregivers recruited consecutively from the University of Alabama-Birmingham Division of Pediatric Gastroenterology and Nutrition at the Children's Hospital of Alabama. The mean age of the sample was 11.77 years (*SD* = 7.16) and 68.2 % of the sample was female. The sample was primarily Caucasian (81.8%) with 7 African-Americans and 1 Native American. Participating caregivers primarily were mothers (88.6%) but also included 3 grandmothers, 1 father, and 1 other. 70.5 % of the caregivers had completed educational work beyond high school and 63.7% of the families had household incomes of less than $40,000. 50% of the participants lived in two-parent households while the remainder of the sample lived in one-parent households. The demographic characteristics of the current sample are representative of the FAP population for the Division of Pediatric Gastroenterology and Nutrition and are similar to reported demographic characteristics of other studies on children with FAP (e.g., Compas et al., 2006; Dorn et al., 2003; Kaufman et al., 1997), including those studies conducted in similar geographic areas (e.g., Garber, Van Slyke, & Walker, 1998; Walker et al., 2006).

The FAP diagnosis was based on Rome III (Rasquin et al., 2006) criteria, which requires episodic or continuous abdominal pain at least once per week for 2 months that does not meet criteria for other functional gastrointestinal disorders and has no known organic disease process.

Exclusion criteria included known mental retardation or pervasive developmental disorder and non-English speakers. 18.2% of the sample had an anxiety disorder diagnosis, while 22.7% of the sample had an ADHD diagnosis with 13.6% taking medications for ADHD[1]. Table 1 provides caregiver-reported descriptive information regarding the frequency and duration of abdominal pain episodes, as well as number of missed school days and doctors visits during the previous year.

Power Analyses.   In order to reliably detect anticipated effect sizes ranging from .15 to .25 power analyses revealed that sample sizes of 33 to 54 participants, 42 to 67 participants, 48 to 76 participants, and 53 to 84 participants for multiple regression analyses with one, two, three, and four predictors, respectively, were needed (Soper, 2009). For hierarchical multiple regression analyses with a total of four predictors, a sample size of 44 to 69 participants was needed to identify effects sizes ranging from .15 to .25 (Soper, 2009).

Measures

Behavior Rating Inventory of Executive Function (BRIEF). The BRIEF (Gioia et al., 2000) is an 86-item, parent-report measure of EF in children ages 5-18. The BRIEF provides eight empirically and theoretically based clinical scales for the various components of EF: Inhibit, Shift, Emotional Control, Initiation, Working Memory, Plan/Organize, Organization of Materials, and Monitor. The Inhibit, Shift, and Emotional Control scales comprise the Behavioral Regulation Index (BRI), while the remaining scales form the Metacognition Index (MCI). The sum of the eight clinical scales comprises the Global Executive Composite (GEC). Higher ratings on the BRIEF indicate greater levels of perceived impairment. Test-retest reliability correlations also are high and range from .72 to .84 after 3-week intervals in clinical populations and from .76 to .88 after 2-week intervals in the normative sample. Mean internal consistency ratings for the parent form are high in both clinical and normative samples and range from .82-.98. In this study the Cronbach alpha was .98. The BRIEF manual (Gioia et al., 2000) provides evidence of construct validity by reporting strong correlations between scales that comprise the BRIEF and relevant scales of the ADHD Rating Scale-IV (DuPaul, Power, Anastopoulos, & Reid, 1998), the Child Behavior Checklist (CBCL: Achenbach, 1991), and Behavior Assessment System for Children (Reynolds & Kamphaus, 1992).

Test of Everyday Attention for Children (TEA-Ch). The TEA-Ch (Manly, Robertson, Anderson, & Nimmo-Smith, 1999) was adapted from the widely used Test of Everyday Attention (TEA; Robertson, Ward, Ridgeway, & Nimmo-Smith, 1995) for adults and normed for use with school-age children, ages 6-16. The TEA-Ch has been shown to reliably distinguish children with ADHD (Heaton et al., 2001) and children with traumatic brain injury (Manly et al., 1999) from controls. Structural equation modeling has shown that the nine subtests of the TEA-Ch measure three aspects of attention: selective attention, sustained attention, and attentional control (switching). Selective attention is considered to be the ability to efficiently identify elements of stimuli that are important to a task and resist distraction (Manly et al., 1999). Sustained attention is the ability to focus attentional resources on a task and attentional control is the ability to switch attention from one stimulus to another (Manly et al., 1999). Each subtest of the TEA-Ch provides a standard score (M = 10, SD = 3) that is based on the test's normative sample.

Participants in this study were administered five subtests of the TEA-Ch that assess all three aspects of attention: *Sky Search, Creature Counting, Sky Search DT, Score DT, and Opposite Worlds*. *Sky Search* is a measure of selective attention where the child identifies and circles target shapes on a sheet filled with similar distracter shapes. The performance on this task is then compared to a task that does not include distracter shapes to serve as a control for motor speed. The subsequent *Sky Search* attention score provides a measure of selective attention that is free from the effects of motor skills. Within the normative sample, test-retest reliability for *Sky Search* is high after a two-week period (r = .75; Manly et al., 1999). The TEA-Ch manual (Manly et al., 1999) also provides evidence of construct validity by reporting significant correlations between *Sky Search* attention scores and performance on Object Assembly from the Wechsler Intelligence Scale for Children, Third Edition (WISC-III: Wechsler, 1991), the Stroop task (Trenerry, Crosson, DeBoe, & Leber, 1989), and Trails A and B (Spreen & Strauss, 1991).

Creature Counting is a measure of attentional control and mental flexibility where the child counts creatures along a path. The task demands switching between counting upwards and counting downwards depending on the presence of up or down arrows. The *Creature Counting* timing score, which is the amount of time required to complete trials of the task correctly divided by the number of switches in those trials, serves as a measure of attentional control. Test-retest correlations for this measure range from .57 for the timing score and .71 for the accuracy score (Manly et al., 1999). The *Creature Counting* subtest is significantly correlated with other measures of attention and executive function including the Stroop task (Trenerry et al., 1989) and Trails B (Spreen & Strauss, 1991).

Sky Search DT measures sustained attention and combines the tasks of circling target stimuli from the *Sky Search* subtest with counting the number of tones heard on a recording. The child's performance in terms of circling the target shapes while simultaneously counting is compared to their previous performance on *Sky Search* and produces the *Sky Search DT* decrement score. The decrement score provides an indication of the child's ability to sustain and allocate attention while performing more than one activity. Test-retest reliability for the *Sky Search DT* decrement scores are high (r = .81) and they are significantly correlated with Trails A and Object Assembly from the WISC-III (Manly et al., 1999).

Score DT is a sustained attention task that requires the child to count the number of tones he/she hears while also listening for another target stimulus (animal name spoken during a news report). This task demands that the child strategically allocate and sustain attention over time. Although ceiling effects prevent the reporting of meaningful test-retest reliability correlations, the percentage agreement within 1 standard deviation between the first and second administration for this subtest is 71.4% (Manly et al., 1999). A structural equation model showed that, of the TEA-Ch subtests that measure sustained attention, *Score DT* has the highest observed fit ($R^2 = 0.32$) with the construct of sustained attention (Manly et al., 1999). Performance on *Score DT* is significantly correlated with the number of errors on the Matching Familiar Figures Test (MFFT; Arizmendi, Paulsen, & Domino, 1981), which measures a child's ability to resist impulsive responses.

The *Opposite Worlds* subtest is a measure of attentional control that asks the child to read aloud digits (1 or 2) intermittently listed on a worksheet and to either say the number or the opposite number of the digit that is presented depending on the presence of a target stimulus, thus requiring inhibition of a normal response. The two-week test-retest reliability correlation for the *Opposite Worlds* subtest is high after a two-week period ($r = 0.85$; Manly et al., 1999). In comparison to the other subtests measuring attentional control and switching, *Opposite Worlds* has the highest observed fit ($R^2 = 0.59$) with the construct (Manly et al., 1999). The *Opposite Worlds* subtest also has adequate construct validity, evidenced by its significant correlations with performance on the Stroop task (Trenerry et al., 1989), the Trails test (Spreen & Strauss, 1991), and MFFT (Manly et al., 1999).

Responses to Stress Questionnaire-Abdominal Pain Version (RSQ). The RSQ (see Appendix A; Connor-Smith et al., 2000) is a 57-item measure of coping that is based on Compas and colleagues' (2001) conceptualization of stress responses. Previous studies have used the RSQ in samples of children with chronic abdominal pain to find relations between different coping responses and somatic complaints, as well as symptoms of depression and anxiety (Compas et al., 2006; Thomsen et al., 2002). While there are both parent-report and child-report versions of the RSQ, this study employed the child version. The RSQ lists items reflecting both voluntary and involuntary, as well as engagement and disengagement, responses to abdominal pain and asks how often each response was used to deal with the stressor in the past 6 months. The RSQ attempts to account for social desirability bias by asking for an example of a specific coping response for items that are likely to garner socially desirable responses.

A factor analysis confirmed Compas et al.'s (2001) five-factor model of stress responses: primary control engagement (e.g., "I try to think of different ways to make my stomachache feel better or go away"), secondary control engagement (e.g., "I tell myself that everything will be alright"), disengagement coping (e.g., "I deal with my stomachaches by wishing that they would just go away"), involuntary engagement (e.g., "When I am having a stomachache, I can't stop thinking about it when I try to sleep"), and involuntary disengagement (e.g., "My mind just goes blank when I have a stomachache, I can't think at all"). This study used the proportion of the total responses for each factor in all correlations and regression and mediation analyses in order to control for individual differences in the amount of responses to stressors (Thomsen et al., 2002; Vitaliano, Maiuro, Russo, & Becker, 1987). The RSQ also measures how stressful episodes of abdominal pain are for the respondent on a four-point scale (1 = not at all, 2 = a little, 3 = somewhat, 4 = very), providing a stress summary score. Test-retest reliability correlations for the five factors on the social stress version range from .69 to .81 (Connor-Smith et al., 2000). Internal consistencies for these factors in a sample of children with RAP range from .67 to .88 (Connor-Smith et al., 2000). The Cronbach alpha for the RSQ in this study was .91.

Multidimensional Anxiety Scale for Children – 10-item form (MASC-10). The MASC-10 (March, Parker, Sullivan, Stallings, & Conners, 1997) is a self-report inventory of anxiety symptoms that is comprised of 10 items from the full 39-item MASC. Respondents rate themselves on 10 anxiety symptoms using a four-point Likert scale. The MASC-10 was developed from the MASC by taking the four highest loading items for the four subscales of the

MASC (physical symptoms, harm avoidance, social anxiety, and separation anxiety), performing a factor analysis on these 16 items, and removing the lowest loading item; this process was repeated until 10 items remained. The MASC-10 has been shown to have adequate-to-excellent test-retest reliability (March, Sullivan, & Parker, 1999), to successfully differentiate anxious and depressed children (Rynn et al., 2006), and to be highly correlated with the total score from the original MASC (r = .90; March, 1997). The total score from the MASC-10 was used to examine the relation between coping approaches and symptoms of anxiety. It also was administered to control for the influences of EF and attention regulation on pain and functional disability since anxiety has been shown to mediate the relation between stress and pain (White & Farrell, 2006). The Cronbach alpha for the MASC-10 in this study was .73.

Behavioral Assessment System for Children-Second Edition (BASC-2). The BASC-2 Parent Rating Scale (PRS; Reynolds & Kamphaus, 2004) is a multidimensional rating scale of child and adolescent behavior. The BASC-2 provides information on adaptive behavior and internalizing and externalizing behavior problems. Unlike the CBCL (Achenbach & Rescorla, 2001) the BASC-2 has clinical scales that distinguish anxiety from depression. Individual scales include anxiety, depression, attention problems, hyperactivity, somatization, and activities of daily living. Internal consistency coefficient alphas on both forms of the PRS for the Internalizing and Externalizing composite scales are high, ranging from .90 to .94, and reliabilities for individual scales also are high, with median values ranging from .83 to .87 (Reynolds & Kamphaus, 2004). Test-retest reliability correlations for the composite scales range from .78 to .92 and median correlations for the individual scales are .84 for the child form and .81 for the adolescent form (Reynolds & Kamphaus, 2004). Reynolds and Kamphaus (2004) have demonstrated the validity of the BASC-2 PRS through several studies showing moderate to high correlations between scales on the BASC-2 PRS and similar scales on other widely used measures of behavior, including the CBCL (Achenbach & Rescorla, 2001), the BRIEF (Gioia et al., 2000), and the Conners' Parent Rating Scale-Revised (Conners, 1997). The BASC-2 Depression subscale served as a measure of depressive symptoms in secondary analyses.

Pain Catastrophizing Scale for Children (PCS-C). Crombez and associates (2003) adapted the PCS-C (see Appendix B), a 13 item self-report measure of catastrophic thinking in response to pain for children, from the Pain Catastrophizing Scale (Sullivan et al., 1995) that is widely used in research with adults. A confirmatory factor analysis revealed that the PCS-C assesses the three dimensions of rumination, magnification, and helplessness (Crombez et al., 2003). Internal consistencies for the PCS-C range from .87 in a community sample to .90 in a clinical sample of children with chronic pain. In this study, the internal consistency coefficient was .83. The PCS-C also was given as a control variable for the analyses examining the influences of EF and attention regulation on pain and functional disability since pain catastrophizing has been related to higher levels of pain and disability in children (Crombez et al., 2003; Vervoort, Goubert, Eccleston, Bijttebier, & Crombez, 2006).

Faces Pain Rating Scale. The Faces Pain Rating Scale (Wong & Baker, 1988) is a brief measure of pain intensity that presents 6 pictures of faces demonstrating progressively worse levels of pain ranging from "no hurt" to "hurts worst". Each picture has a number associated with it ranging from 0-5. Children reported their current pain level along the continuum by indicating a face and/or number that serves as their pain score. The Faces Pain Rating Scale has been used extensively in research on pain in children and adolescents and has been shown to be a reliable and valid measure for use with children and adolescents (Wong & Baker, 1988). The

Faces Pain Rating Scale acted as a measure of current pain during the attention tasks of the TEA-Ch in order to examine the effects of pain on attention regulation (Eccleston & Crombez, 1999).

Abdominal Pain Index (API). The API (see Appendix C; Walker et al., 1997) is a well-validated, five-item measure of the intensity, frequency, and duration of abdominal pain experienced during the previous 2 weeks. The API assesses the frequency of pain on a six-point scale ranging from "*not at all*" to "*every day*." A six-point scale is used to assess the typical frequency of pain episodes per day (*none, once a day, two or three times a day, four or five times a day, six or more times during the day, constant during the day*). The typical duration of the pain episodes is rated using a nine-point scale (*no pain, a few minutes*, *about half an hour, between one and two hours, three or four hours, most of the day, all day*). Both maximum and typical pain intensity are rated using a 10-point scale ranging from *no pain* to the *most pain possible.* Responses to the five items are standardized and summed to create the API index score. In different samples, alpha reliabilities for the API range from .78 to .93 (Boyer et al., 2006; Thomsen et al., 2002; Walker et al., 1997). For this study, the Cronbach alpha was .81.

Functional Disability Inventory (FDI). The FDI (see Appendix D; Walker & Greene, 1991) is a 15-item questionnaire that assesses children's difficulty in performing different activities across multiple contexts (school, home, social) due to their physical health over the past 2 weeks. This study employed the parent form of the FDI only in order to reduce the amount of time required of each participant. The parent form of the FDI has high internal consistency, with coefficients ranging from .86 to .95, and acceptable 2-week test-retest reliability (Claar & Walker, 2006; Walker & Greene, 1991). The internal consistency for the FDI in this study was .93. Walker and Greene (1991) found that child and parent reports on the FDI correlate highly with one another ($r = .71$, $p < .001$), with school absences ($r = .52$, $p < .001$

for child report, $r = .55$, $p < .001$ for parent report), and with somatic complaints ($r = .65$, $p < .001$ for child report, $r = .47$, $p < .001$ for parent report), demonstrating the FDI's validity.

Demographics. Each caregiver completed a demographic questionnaire (see Appendix E) that assessed information regarding ethnicity; educational background; household income; current medications; and pre-existing psychiatric history, including anxiety disorder and ADHD diagnoses. This questionnaire also included items assessing factors related to the diagnosis of FAP, including number of pain episodes in the past 12 months, length of time with abdominal pain, number of school days missed due to abdominal pain, and number of doctors' visits due to abdominal pain.

Procedure

Participants were patients diagnosed with FAP recruited consecutively from the University of Alabama-Birmingham Division of Pediatric Gastroenterology and Nutrition at the Children's Hospital of Alabama. Recruitment and data collection occurred during regularly scheduled clinic appointments. Potential participants were identified by the medical team during the week prior to their clinic appointment and contacted by the research team via phone to remind them of their clinic appointment and inform them of the study. Previously identified FAP patients and those who missed their scheduled appointments also were mailed a letter about the study.

The experimenter or a research assistant approached and introduced the study to eligible patients during their scheduled visit. Informed consent was obtained from parents or legal guardians and assent from children and adolescents. Following consent, parents completed the demographics questionnaire, the FDI, the BRIEF, and the BASC-2. In a separate room, participants were administered the Faces Pain Rating Scale, the TEA-Ch subtests, the API, the RSQ, the MASC-10, the PCS-C. The self-report measures were administered to the participant orally: the experimenter read aloud the questions and the participant indicated his/her answer. Participants were compensated with $20 cash.

Data Analyses

Two series of analyses tested each of the present study's hypotheses, one with API scores as the dependent variable and the other with FDI scores as the dependent variable. Three attention variables were created based on the administered TEA-Ch subtests and their corresponding attentional constructs. The *Sky Search* attention standard score represented the participant's selective attention abilities. Sustained attention was comprised of the average of the *Sky Search DT* standard score and the *Score DT* standard score. The average of the *Creature Counting* and *Opposite Worlds* standard scores served as the measure of attentional control. Each analysis included only one construct of attention regulation at a time because of the weak correlation between selective attention and sustained attention (see Table 2). Due to the strong correlations between the eight clinical scales, and between the BRI and MCI, on the BRIEF (see Table 3), the GEC raw score served as the EF predictor in all analyses. Analyses involving the coping variables only included the voluntary coping responses from the RSQ: primary control engagement, secondary control engagement, and disengagement coping.

CHAPTER 3

RESULTS

Child Reports of Pain and Levels of Stress.

Means and standard deviations for responses to the API are presented by age group in Table 4. Participants reported having frequent abdominal pain episodes in the two weeks prior to their clinic appointment with 59.1% of participants reporting abdominal pain on at least 3 days and 38.6% reporting abdominal pain most days. In addition, 56.9% of participants reported typically having multiple episodes of abdominal pain each day and 75% of the sample noted that the pain episodes generally last longer than half an hour. In regards to the average intensity, participants in the sample reported experiencing a moderate amount of pain over the past 2 weeks (M = 5.41 on scale ranging from 0 to 10, SD = 2.53). Typical maximum intensity of the abdominal pain during the previous 2 weeks was 6.43 (SD = 2.38). Pain at the time of the assessment was significantly related to the frequency of abdominal pain episodes over the last two weeks ($r = .39$, $p < .01$) and the typical frequency of episodes in a given day ($r = .31$, $p < .05$) but not to the duration or intensity of pain episodes or the API index score. Lower caregiver educational attainment was significantly related to longer duration of pain episodes ($r = -.36$, $p < .05$), higher levels of typical pain intensity ($r = -.40$, $p < .01$) and total pain problems ($r = -.33$, $p < .05$). Being older also was significantly related to the frequency of pain episodes ($r = .33$, $p < .05$), the typical maximum intensity of pain episodes ($r = .30$, $p < .05$), and total abdominal pain problems ($r = .32$, $p < .05$).

Participants generally reported that their episodes of abdominal pain were "somewhat stressful" for them (M = 3.03, SD = .83). Higher ratings of abdominal pain-related stress were significantly related to longer duration of pain episodes (r = .38, p < .05), higher rates of pain catastrophizing (r = .34, p < .05), and more visits to a doctor (r = .32, p < .05).

Descriptive and Preliminary Analyses.

Means and standard deviations for the measures of EF, attention regulation, coping, pain, functional disability, anxiety, depression, and pain catastrophizing variables are presented in Table 5. Parents reported modest elevations in executive dysfunction according to the mean BRIEF GEC *T* scores (M = 58.20, SD = 11.99). Mean performance on the TEA-Ch attention constructs were in the borderline-to-low average range as evidenced by standard scores ranging from 6.0-8.23. Participants in the sample particularly had difficulty with the subtests measuring sustained attention (M = 6.70, SD = 2.85) and attentional control (M = 6.00, SD = 3.44). Parents reported moderate amounts of pain-related functional disability for their children with a wide range of disability (0-60). Although participants reported engaging in all three types of coping responses to abdominal pain, they reported using significantly more disengagement coping strategies (M = 1.53, SD = .53) than secondary control engagement coping strategies (M = 1.34, SD = .57; t[43] = -2.64, $p < .05$). There was also a trend for participants to engage in more primary control engagement coping strategies (M = 1.53, SD = .61) than secondary control engagement coping strategies (M = 1.34, SD = .57; t[43] = 1.82, p = .07). Mean proportion scores for the different coping factors were .19 for primary control engagement coping, .16 for secondary control engagement coping, and .25 for voluntary disengagement coping.

Neither participant sex nor parent marital status was significantly related to pain, functional disability, coping, EF, variables of attention regulation, self-reported anxiety, caregiver-reported depression, or pain catastrophizing. Better attentional control on the TEA-Ch was significantly related to more parental education (r = .33, $p < .05$).

Correlational Analyses.

The correlations between the measures of EF, the attention regulation variables, coping, pain, functional disability, anxiety, depression, and pain catastrophizing are presented in Table 6. It is worth noting that only 10 of the 66 possible correlations were significant, therefore some of the significant correlations are likely due to chance. With a larger sample size, some of the correlations in the .2-.29 range may have been significant. In addition, many of the nonsignificant correlations were not related to the current study's aims and hypotheses and not expected to be significant.

Neither pain level at the time of study participation nor length of time since first being diagnosed with FAP was significantly correlated with any of these variables. Interestingly, levels of functional disability were not related to difficulties with abdominal pain but were significantly related to more caregiver-reported doctor visits (r = .37, $p < .05$).

Better sustained attention on the TEA-Ch was significantly related to fewer caregiver-perceived problems of EF on the BRIEF (r = -.50, $p < .01$). Better performance on the selective attention task was significantly related to increased use of secondary control coping strategies (r = .33, $p < .05$). However, contrary to hypotheses, better selective attention also was significantly related to increased use of voluntary disengagement coping strategies (r = .39, $p < .01$). Given the exploratory nature of the study and the unexpected finding of both secondary control coping and disengagement coping being significantly related to selective attention, exploratory bivariate Pearson correlation analyses were run with the secondary factors comprising secondary control coping (positive thinking, cognitive restructuring, and acceptance), disengagement coping (avoidance, denial, wishful thinking, and distraction), and selective attention to identify the specific relations between these variables. Results are presented in Table 7. Consistent with what might be expected, more frequent use of cognitive restructuring strategies was significantly related to less use of wishful thinking ($r = -.32$, $p < .05$). Contrary to what might be expected, increased use of positive thinking was significantly related to higher usage of denial ($r = .47$, $p < .01$). There were also trends for increased use of positive thinking being related to more frequent use of distraction ($r = .28$, $p = .06$), as well as higher rates of avoidance strategies being related to more use of denial ($r = .26$, $p = .08$). Better selective attention abilities were significantly related to increased use of acceptance ($r = .48$, $p < .01$) and wishful thinking ($r = .40$, $p < .01$).

There were no other significant relations between the coping variables, attention regulation variables, and EF. Also opposite to the expected findings, EF and the attention regulation variables were not related to levels of pain or functional disability, although there was a trend for better attentional control and lower functional disability ($r = -.28$, $p = .07$).

Increased rates of pain catastrophizing were related to poorer sustained attention ($r = -.32$ $p < .05$) and less use of primary control coping strategies ($r = -.30$ $p < .05$). Examination of the correlations between the three factors of the PCS-C and sustained attention revealed significant negative relations between sustained attention and magnification ($r = -.40$, $p < .01$) and helplessness ($r = -.31$, $p < .05$). Primary control coping also had a significant negative relation with magnification ($r = -.31$, $p < .05$). There also was a trend for increased pain catastrophizing and poorer attentional control ($r = -.29$, $p = .056$). Self-reported levels of anxiety were significantly related to caregiver-reported number of missed school days ($r = .35$, $p < .05$). More caregiver-identified symptoms of depression was significantly related to higher levels of caregiver-reported EF difficulties (r = .57, p < .01) and poorer sustained attention performance (r = -.47, p < .01).

None of the coping variables was significantly related to rates of pain, functional disability, or symptoms of depression. There was a trend for increased use of secondary control coping strategies and lower rates of functional disability (r = -.27, p = .07). Self-reported symptoms of anxiety were unrelated to primary control coping and disengagement coping. Secondary control coping strategies, however, were inversely related to self-reported symptoms of anxiety (r = -.41, p < .01).

Primary Hypotheses.

Predicting Coping. Multiple regression models examined the strength of EF and the individual attention regulation variables as predictors of primary control coping, secondary control coping, and disengagement coping. Results from these analyses are presented in Tables 8, 9, and 10. The model that included EF and selective attention as predictors accounted for a significant amount of variance in the proportion of secondary control coping strategies used [$F(2, 40) = 3.3$, $p < .05$] and represented a medium effect (Cohen's $f^2 = .16$). Examining the individual coefficients, better selective attention skills emerged as a significant predictor of increased use of secondary control coping strategies ($t[43] = 2.42$, $p < .05$).

In addition, EF and selective attention together significantly predicted the proportion of voluntary disengagement strategies used [$F(2, 40) = 4.23$, $p < .05$] and had a medium effect (Cohen's $f^2 = .18$). Contrary to hypotheses, better selective attention abilities were significantly related to increased use of disengagement coping ($t[43] = 2.58$, $p < .05$).

Although other overall models predicting the different coping strategies were not significant, there was a trend for increased use of secondary control coping with better attentional control ($t[43] = 1.91$, $p = .06$).

Predicting Abdominal Pain and Functional Disability. Three hierarchical linear regression models tested the predictive ability of EF and the attention regulation variables on pain above and beyond the contributions of control variables. There were two steps to each model predicting pain. Participant age and caregiver education were entered into the model first due to their significant correlations with abdominal pain, followed by EF and an individual attention regulation variable. R^2 change and Cohen's f^2 were used to calculate effect sizes. The results from these models are presented in Table 11. In the first step of each model, participant age and caregiver education accounted for 22% of the variance in abdominal pain [$F(2, 40) = 5.49$, $p < .01$], which represented a medium effect. Increased difficulties with abdominal pain were significantly related to older participant age ($t[43] = 2.24$, $p < .05$) and less caregiver education ($t[43] = -2.16$, $p < .05$). Adding EF and the separate attention regulation variables to the models in step two did not significantly improve the predictive ability of the model in terms of accounting for variance in abdominal pain (R^2 change ranged from .01-.03, $p > .50$). However, the overall models for selective attention [$F(4, 38) = 2.98$, $p < .05$], sustained attention [$F(4, 38) = 3.05$, $p < .05$], and attentional control [$F(4, 38) = 2.74$, $p < .05$] remained significant.

Three multiple regression models tested the predictive ability of EF and the different attention regulation variables separately on functional disability. No covariates were included in the model because no significant correlations were observed between other notable variables and functional disability. The results for these models are presented in Table 12. None of these models were significant.

Mediation Analyses. Bootstrapping procedures for mediation (Preacher & Hayes, 2008) directly tested the significance of the indirect effects of EF and the three attention regulation variables on pain and functional disability through voluntary engagement coping responses. This approach addresses some of the shortcomings associated with the traditional Baron and Kenny (1986) approach to mediation, including improving power and reducing the probability of Type I and II errors (for review, see Preacher & Hayes, 2004). Unlike Sobel tests of mediation (Sobel, 1982) the bootstrapping procedure is a nonparametric approach that allows for non-normal distributions and smaller sample sizes. 5000 iterations were used for each bootstrapping model.

95% confidence intervals were used to determine the specific indirect effects of proposed mediator variables. A variable is considered to significantly mediate the relation between the independent and dependent variables if zero is not contained within the 95% confidence intervals

Two bootstrapping analyses examined the indirect effects of each independent variable on each dependent variable through either primary control coping or secondary control coping. The analyses with pain as the dependent variable included participant age and caregiver education as covariates in order to control for the significant correlations between these variables and pain. Two bootstrapping models explored the indirect effects of EF on pain through the two types of coping strategies. Results are presented in Table 13. The first of these tested whether primary control coping mediates the relation between EF and pain. Both the direct effects of EF on pain (-0.0003, $p > .80$) and the total effects of EF on pain (0.0003, $p > .80$), that include direct and indirect effects, were non-significant. Results indicated that primary control coping does not mediate the relation between EF and pain since the 95% confidence intervals include zero.

A second bootstrapping model tested the indirect effects of EF on pain through secondary control coping while including the covariates. Results revealed that both the direct (-0.0008, $p > .80$), and total effects (0.0003, $p > .80$) of EF on pain in this model were non-significant. The 95% confidence intervals indicate that secondary control coping was not a significant mediator of the relation between EF and pain.

Two bootstrapping models examined the indirect effects of selective attention on pain through either primary control coping or secondary control coping while including the covariates. Results for these two models are presented in Table 14. The first model tested primary control coping as the mediator. The direct effects (0.0353, $p < .32$) and total effects (0.0395, $p < .30$) of selective attention on pain were both non-significant. The 95% confidence intervals for primary control coping include zero, indicating that there is not a specific indirect effect of selective attention on pain through primary control coping.

The next bootstrapping model tested the indirect effects of selective attention on pain through secondary control coping while accounting for covariates. Direct (0.0298, $p < .42$) and total effects (0.0395, $p < .30$) of selective attention on pain were not significant. Secondary control coping did not mediate the relation between attention regulation and pain.

Another set of two bootstrapping models tested the indirect effects of sustained attention on pain through coping. Results are presented in Table 15. The first of these models examined whether primary control coping mediated the relation between sustained attention and pain while accounting for covariates. The direct (0.0470, $p < .24$) and total effects (0.0166, $p < .70$) of sustained attention on pain in this model were not significant. Confidence intervals for primary control coping indicated that it did not mediate the relation between sustained attention and pain.

The next bootstrapping model tested the indirect effects of sustained attention on pain through secondary control coping. The direct (0.0504, $p < .21$) and total effects (0.0166, $p < .70$) of sustained attention on pain in this model were not significant. Secondary control coping was not a mediator of the relation between sustained attention and pain.

Another two bootstrapping models examined the indirect effects of attentional control on pain through either primary control coping or secondary control coping while including the covariates. Results are presented in Table 16. The first model tested whether primary control coping mediated the relation between attentional control and pain. Direct effects (0.0173, $p < .62$) and total effects (-0.0198, $p < .58$) of attentional control were not significant. The 95% confidence intervals indicate that primary control coping is not a significant mediator.

A second model tested the indirect effects of attentional control on pain through secondary control coping. Direct effects (0.0114, $p < .75$) and total effects (-0.0198, $p < .58$) of attentional control were not significant. Secondary control coping did not mediate the relation between attentional control and pain.

The second set of mediation analyses tested the indirect effects of EF and the attention regulation variables on functional disability through primary control coping and secondary control coping individually. Two models tested whether primary control coping and secondary control coping mediated the relation between EF and functional disability. Results are presented in Table 17. The first model assessed the indirect effects of EF on functional disability through primary control coping. The direct (0.0310, $p > .05$) and total (0.0334, $p > .05$) effects of EF on functional disability were not significant. The 95% confidence intervals show that EF did not have significant indirect effects on functional disability through primary control coping strategies because they did not include zero.

The second model tested whether or not secondary control coping mediated the relation between EF and functional disability. Neither the direct (0.0486, $p > .05$) nor the total effects (0.0334, $p > .05$) of EF on functional disability in this model were significant. Secondary control coping did not mediate the relation between EF and functional disability.

Two models examined the indirect effects of selective attention on functional disability through either primary control coping or secondary control coping. Results are presented in Table 18. The first of these models explored whether primary control coping mediated the relation between selective attention and functional disability. Both the direct (-0.3919, $p < .54$) and total effects (-0.4116, $p < .52$) of selective attention on functional disability were not significant. As evidenced by the inclusion of zero in the 95% confidence intervals, primary control coping did not significantly mediate the relation between selective attention and functional disability.

The second bootstrapping model with selective attention tested whether secondary control coping mediated the relation between selective attention and functional disability. Direct (-0.0519, $p < .94$) and total effects (-0.4116, $p < .52$) of selective attention on functional disability were not significant. Selective attention did not have an indirect effect on functional disability through secondary control coping.

Another two bootstrapping models examined the indirect effects of sustained attention on functional disability through either primary control coping or secondary control coping. Results are presented in Table 19. The first model tested whether primary control coping mediated the relation between sustained attention and functional disability. Direct (-0.8409, $p < .24$) and total effects (-0.8095, $p < .26$) of sustained attention on functional disability were not significant. 95% confidence intervals revealed that primary control coping was not a significant mediator.

The second model tested the indirect effects of sustained attention on functional disability through secondary control coping. Direct (-0.8995, $p < .20$) and total effects (-0.8095, $p < .26$) of sustained attention on functional disability were not significant. Secondary control coping did not mediate the relation between sustained attention and functional disability.

The final two bootstrapping models examined the indirect effects of attentional control on functional disability through the two coping variables. Results are presented in Table 20. The first of these models tested whether primary control coping mediated the relation between attentional control and functional disability. Direct (-1.0055, $p < .09$) and total effects (-1.0411, $p < .08$) trended towards significance. Primary control coping did not mediate the relation between attentional control and functional disability.

The final bootstrapping model tested the indirect effects of attentional control on functional disability through secondary control coping. The direct effect of attentional control on functional disability (-0.1576, $p < .16$) was not significant but the total effects of attentional control on functional disability trended towards significance (-1.0411, $p < .08$). The 95% confidence intervals indicate that secondary control coping did not significantly mediate the relation between attentional control and functional disability.

Secondary Analyses.

Coping and Adjustment. Two multiple regression models tested the strength of engagement and disengagement coping responses as predictors of anxiety and depression. Table 21 presents the complete results from these regression analyses. The first model examined the predictive ability of primary control, secondary control, and disengagement coping responses on self-reported anxiety. R^2 and Cohen's f^2 were used to calculate effect size.

Results revealed that primary control, secondary control, and disengagement coping responses accounted for 18% of the variance in self-reported anxiety [F (3, 40) = 2.85, $p < .05$] and had a medium effect (Cohen's $f^2 = .22$). Examination of the individual coping variables indicated that increased rates of secondary control coping significantly predicted fewer self-reported symptoms of anxiety ($t[43] = -2.66$, $p < .01$).

Given the significant relations between selective attention and secondary control coping and between secondary control coping and anxiety, an exploratory bootstrapping model examined the indirect effects of selective attention on anxiety symptoms through secondary control coping. Results from this analysis are presented in Table 22. Direct (-0.1524, $p < .58$) and total effects (-0.3840, $p < .17$) of selective attention on symptoms of anxiety were not significant. 95% confidence intervals, however, revealed that secondary control coping significantly mediated the relation between selective attention and anxiety since zero was not contained in any of the confidence intervals.

Another multiple regression model evaluated the strength of the different voluntary responses to stress as predictors of caregiver-reported depression. This model showed that coping responses did not account for a significant amount of variance in caregiver-reported levels of depression.

Pain Catastrophizing. Bivariate Pearson correlation analyses examined the relation between pain catastrophizing and pain, functional disability, and anxiety. The correlations are presented in Table 6. No significant relations emerged between pain catastrophizing and the other notable variables.

CHAPTER 4

DISCUSSION

Previous investigations into the role of coping in children with chronic abdominal pain have demonstrated the importance of adaptive coping mechanisms (Compas et al., 2006; Kaminsky et al., 2006; Thomsen et al., 2002; Walker et al., 1997). Variability in the type and quality of coping response is related to different psychosocial and functional outcomes in pediatric pain populations. Potential mechanisms of variability in coping are individual differences in EF and attention regulation abilities. Previous research has shown that components of EF abilities indirectly influence behavioral adjustment in ALL survivors through coping (Campbell et al., 2009). Identifying potential factors that affect children's coping with stressors is important in order to recognize individuals who require modified interventions or more concrete training in the application of effective coping strategies.

This exploratory study is one of the first to examine the influences of EF and attention regulation abilities on coping and outcomes in children with a recurrent pain condition and provides a framework for future investigations of neurocognitive factors affecting coping. Although the small sample size likely reduced the ability to detect small yet potentially meaningful relations between variables and limited the number of significant finding, results from this preliminary study provide partial support for the hypotheses. While some components of attention regulation were related to the type of coping strategy used, EF and attention regulation were not predictors of pain problems or functional disability, and there were no indirect effects of EF and attention regulation on pain or functional disability through coping.

Secondary exploratory analyses, however, found evidence for the indirect effects of a component of attention regulation on anxiety through coping.

This study explored whether children and adolescents' EF and attention regulation skills were related to the types of coping strategies used during abdominal pain episodes. Contrary to hypotheses, neither EF nor the attention regulation variables emerged as a significant predictor of using primary control coping strategies. This suggests that EF and attention regulation are not related to the practice of identifying solutions to reduce pain, changing emotional reactions to pain, or expressing emotions to cope with pain episodes in children with FAP. Better executive or attentional resources may not be required for children with FAP to choose these types of coping skills such as relaxation, telling someone else about their emotions, or getting support from someone else as a way to deal with pain.

The data failed to support the hypothesis that better sustained attention, attentional control, or global EF abilities were related to the use of secondary control coping strategies. Consistent with hypotheses, however, selective attention emerged as a significant predictor of using secondary control coping strategies during abdominal pain episodes. Better abilities to effectively and efficiently identify relevant stimuli for a task and ignore distracters were related to increased use of coping strategies that attempt to modify cognitions related to the stressor of abdominal pain. Exploratory correlations revealed that selective attention was particularly related to the cognitive coping skill of acceptance. This suggests that children who efficiently identify what thoughts or stimuli to attend to and which to ignore tend to accept their pain and move on to other activities or thoughts and try to not dwell on their abdominal pain.

This result fits well with selective filter models of attention (see Lachter, Forster, & Ruthruff, 2004). These models emphasize the limited capacity of resources for cognition and action and suggest that stimuli must be selected and allocated attention for further processing. Within the context of coping, attention towards internal and external stimuli is required prior to the engagement in a particular coping strategy. In the initial moments of an episode of abdominal pain, a child must identify the pain as a stressor and allocate attentional resources toward the stressor in order to effectively cope with it. The significant relation between selective attention and the use of secondary control coping strategies in this study suggests that children who efficiently identify relevant stimuli during tasks have a tendency to selectively attend to cognitive stimuli that are positive or adaptive in nature (e.g., “I decide that I am ok even with a stomach ache” or “I tell myself everything will be alright”) while filtering out negative, maladaptive cognitions related to the stimuli. Children with FAP who are attune to their thoughts and can selectively identify relevant thoughts that are adaptive may use these types of positive, cognitive coping strategies more frequently.

This finding has potential implications for interventions with children with FAP. Enhancing children’s efficiency in identifying their cognitions during a pain episode may promote increased use of secondary control coping strategies, such as acceptance. Interventions that target increasing awareness of one’s thoughts and teach ways of distinguishing positive thoughts (e.g., “I am ok even with abdominal pain”) from negative thoughts (e.g., “I can’t stand it anymore”) may improve children’s abilities to selectively attend to more adaptive thoughts while ignoring others during coping attempts.

Interestingly, selective attention also was a significant predictor of disengagement coping. This indicates that efficiently identifying pertinent stimuli for tasks also is related to coping strategies that attempt to remove oneself from the stressor. The exploratory correlations revealed that selective attention specifically was related to wishful thinking, suggesting that children who efficiently identify the thoughts or stimuli to attend to and those to ignore tend to wish that they were different or that the pain would disappear. This finding may be consistent with previous evidence suggesting that children with recurrent abdominal pain demonstrate a subconscious bias towards both social- and pain-related threat words but consciously avoid threat words in favor of neutral words (Boyer et al., 2006). This tendency to consciously avoid threat may explain the reliance on disengagement coping strategies found in the present sample. Children with more developed selective attention skills who are more efficient at identifying threat stimuli may be more likely to use disengagement strategies due to this tendency to avoid stressors.

The significant relation between selective attention and disengagement coping is contrary to the expected relations and proposed model (Compas & Boyer, 2001), as well as the finding with selective attention and secondary control coping. Secondary control coping and disengagement responses are thought to be on opposite ends of the stress response continuum yet these results suggest that children with better selective attention abilities employ both secondary control coping and disengagement coping responses at higher rates than other strategies. Previous investigations of children's coping have found strong negative correlations between secondary control coping and disengagement coping (Campbell et al., 2009; Connor-Smith et al., 2000; Thomsen et al., 2002). However, examinations of the correlation coefficients for the three coping factors in the current sample reveal unexpected relations, including negative relations between primary control coping and secondary control coping and positive relations between secondary control coping and disengagement coping.

The surprising significant correlations between specific aspects of secondary control coping and disengagement coping likely explain the positive relations between these two coping factors. Exploratory correlation analyses indicated that children who engage the stressor of abdominal pain by thinking positively about their ability to handle the pain also use the disengagement strategy of denying that they are even in pain. In addition, there was a trend for increased use of positive thinking to be related to increased use of distraction strategies (e.g., "I think of happy things to take my mind off of my stomach ache or emotions"). These results indicate that in the present sample, positive thinking functions similarly to denial and distraction. Examination of the items on the coping measure (RSQ) that comprise positive thinking (e.g., "I tell myself that I can get through this"), denial (e.g., "When I get a stomachache, I say to myself 'this isn't real'"), and distraction (e.g., "I think about happy things to take my mind of my stomachache or my emotions") suggest the common function of focusing on particular cognitions that help the individual get through a particular episode. This is in contrast to strategies such as cognitive restructuring (e.g., "I think about the things that I'm learning from the situation, or something good that will come from it"), acceptance (e.g., "I decide I am okay the way I am, even though I get stomach aches a lot"), or wishful thinking (e.g., "I wish that I were stronger and less sensitive so that things would be different") that appear to function more as long-term approaches to coping with frequent episodes of abdominal pain.

Overall, the results both support and contradict the expected relations between EF and attention regulation variables and the types of coping responses used. Better selective attention was related to more frequent use of coping strategies that attempt to modify personal reactions to the stressor, as well as those that attempt to disengage from the stressor. These findings provide partial support for the only published study investigating the relations between EF abilities and coping (Campbell et al., 2009) which found better EF abilities predicted increased use of primary control and secondary control coping strategies and less use of disengagement coping responses.

A second objective of this study was to explore whether EF and attention regulation predicted levels of pain or functional disability. This was one of the first investigations into the role of EF and attention regulation in influencing outcomes in a pediatric pain population. Results did not support the hypotheses that better EF and attention regulation variables would be related to fewer pain problems and lower levels of functional disability. Analyses predicting pain problems, however, revealed interesting significant relations between pain and the covariates of participant age and caregiver education. Increased difficulties with abdominal pain difficulties were related to older participant age and less caregiver education. Correlational analyses indicated that older participant age was related to higher maximum pain intensity and more frequent episodes of abdominal pain. This could be related to older participants' tendency to view abdominal pain episodes as more stressful ($r = .24$, $p = .12$), which could exacerbate their pain episodes. Less caregiver education was related to longer duration of pain episodes and higher typical levels of pain intensity in this study. This finding may be explained by a previous study that showed that mothers with less education exhibit more protective behaviors to their children during abdominal pain episodes (Langer et al., 2007). Previous research across multiple pain populations has demonstrated a relation between increased parental protectiveness and higher levels of pain severity (Levy et al., 2004), functional disability (Peterson & Palermo, 2004), and symptom maintenance (Walker, Claar, & Garber, 2002).

Although no significant relations emerged between EF and attention regulation and functional disability, there was a slight trend for better attentional control to be related to lower levels of functional disability ($p = .09$). Children who are better able to shift their attentional focus may be able to divert their attention away from pain sensations and have fewer pain-related difficulties with participating in daily activities. This effect may have been significant with a larger sample size. Future studies with larger sample sizes should continue exploring these relations between attentional control and pain-related disability.

The third primary objective of this study was to examine whether coping mediated the relation between EF and attention regulation and the main outcome variables. In the present sample, individual differences in EF and attention regulation abilities did not indirectly influence either pain or functional disability through any of the coping approaches. Caregiver-identified EF abilities and performance-based attention regulation abilities did not influence the type of coping used, which in turn, did not influence the levels of pain or functional disability. This suggests that varying capacities in EF and attention regulation, as measured in the current study, do not impact children's ability to adapt to episodes of abdominal pain in terms of their pain ratings and levels of functional disability.

A potential reason for these null findings could be the possible heterogeneity within the sample in terms of somatic symptoms and presentation. Eligibility for this study required episodic or continuous abdominal pain at least once per week for 2 months that did not meet criteria for other functional gastrointestinal disorders and had no known organic disease process. However, the present sample may have included children who also meet criteria for functional abdominal pain syndrome (FAPS), which requires functional abdominal pain and either some level of functional disability or additional somatic complaints, such as headache, limb pain, or disturbed sleep (Rasquin et al., 2006). Children with FAPS might be significantly different than children diagnosed with FAP on several variables that affect the strength and nature of the relations between the variables examined in this study. Future research with these populations should compare these different subsets of children with functional abdominal pain to determine if the different presentations contribute to any variability in outcomes or identified relations.

Future studies also could include children with other abdominal pain-related functional gastrointestinal disorders besides FAP, including functional dyspepsia, irritable bowel syndrome, and abdominal migraine, to explore differences in the relations between EF and attention regulation, coping, and outcomes among these different groups to identify predictors of variability in adjustment.

Another possible reason for the null findings in the current study is a potential sample bias. The present sample represents children who were diagnosed with FAP at a previous visit and attended a subsequent medical appointment. Returning for an additional appointment following the initial diagnosis suggests continued difficulties with abdominal pain. Those children diagnosed with FAP who did not return for further medical care and, therefore, did not participate in this study may not have returned due to fewer difficulties with abdominal pain. Such children may cope better and their inclusion in the present study may have provided the variability necessary to observe the hypothesized relations between EF and attention regulation, coping, and the outcome variables.

These results do not support findings from the only published study investigating the influences of EF through coping, which found evidence for indirect effects of components of EF on behavior problems through secondary control coping in ALL survivors (Campbell et al., 2009). The Campbell et al. (2009) study used similar methodology to the current one, employing both performance-based measures of EF, including scales from the Wechsler Intelligence Scales (Wechsler, 2002; 2003) and the Delis-Kaplan Executive Function System (Delis, Kaplan, & Kramer, 2001), as well as the BRIEF (Gioia et al., 2000), which is regarded as an ecologically valid measure of EF. The Campbell et al. (2009) study, however, created composite variables for the different EF domains (e.g., working memory) from the performance-based measures and the BRIEF, as well as for the different coping and outcome variables from both self- and parent-reports. Perhaps these minor differences in methodology contributed to the contrasting findings. Future research examining the role of EF on coping with stressors should employ multi-informant methods similar to Campbell et al. (2009) in order to gain as many perspectives on variables such as coping.

Other potential reasons for the dissimilar findings are differences between the type of sample used for the present study and the Campbell et al. (2009) study. First, the differing level of EF abilities between the two samples may explain the divergent results. The ALL survivor population generally performed in the average range on administered tests of EF and was rated in the average range on the BRIEF (mean range = 51.18-52.14 on reported BRIEF subscales; Campbell et al., 2009), whereas the sample in the present study was rated as having more problems related to executive dysfunction and generally performed in the borderline-to-low average range on administered subtests of attention regulation. It is possible that the generally low levels of EF and attention regulation abilities in this sample of children with FAP limited the amount of variability observed in these variables and, thus, restricted the strength of relations between EF and attention regulation and other variables. The present study did not include a control group and is unable to determine whether children with FAP have increased difficulties with EF and attention regulation in comparison to healthy controls and whether levels of EF uniquely affect the variability in coping in children with FAP. Future research examining the indirect effects of EF and attention regulation on outcomes through coping in children with a pain condition should include a control group to address these issues.

A second potential difference between the two samples that may account for the different results is the nature of the pediatric problem that defined the sample. The sample in the

Campbell et al. (2009) study consisted of children and adolescents who had successfully finished treatment for ALL. This sample faced a potentially life-threatening illness that may have impacted their approaches to coping in a way that made their coping qualitatively different than children with FAP. For example, research has shown that children treated for cancer demonstrate evidence of posttraumatic growth (PTG; Barakat, Alderfer, & Kazak, 2006), which involves applying positive interpretations of the traumatic event and deriving a sense of meaning from it. Given the similarities between PTG and secondary control coping strategies, it may be that those individuals experiencing PTG may engage in more secondary control coping strategies. Examination of the reported proportions for the coping factors on the RSQ in the Campbell et al (2009) study reveals higher rates of secondary control coping strategies in the ALL sample ($m = .26$, $SD = .05$) when compared to the current sample of children diagnosed with FAP ($m = .16$, $SD = .06$). Since children with FAP do not face a potentially life-threatening illness and likely do not experience PTG, they may not engage in as much secondary control coping strategies.

A secondary objective of the present project was to examine the contributions of coping in the psychological adjustment of children with chronic abdominal pain. Consistent with the expected relations and previous studies (Kaminsky et al., 2006; Thomsen et al., 2002; Walker et al., 1997), increased use of secondary control coping was related to lower rates of self-reported anxiety. Primary control coping strategies and disengagement responses were unrelated to anxiety symptoms. This suggests that using internal, cognitive coping strategies are more effective than attempts to modify stressors in promoting psychological adjustment when faced with the unpredictable stressor of episodic abdominal pain. It is notable that of the voluntary coping responses, participants in the sample used secondary control coping strategies the least.

This highlights the importance of increasing the use of secondary control coping strategies in interventions with children with FAP. The current finding adds to the literature by using self-report data for both coping and symptoms of anxiety, whereas previous studies of children with chronic abdominal pain relied on parent-reports (e.g., Thomsen et al., 2002; Walker et al., 1997).

An exploratory analysis revealed that secondary control coping significantly mediated the relation between selective attention and symptoms of anxiety (see Figure 4). This suggests that better selective attention abilities lead to increased use of secondary control coping strategies, which in turn lead to fewer symptoms of anxiety. Although this was an unplanned, follow-up analysis it supports the Campbell et al. (2009) findings by showing that a component of EF or attention regulation has indirect effects on a psychosocial outcome through a particular coping approach. Given that elevated levels of anxiety have been documented in children with chronic abdominal pain (Dorn et al., 2003; Garber, Zeman, & Walker, 1990; Hodges, Kline, Barbero, & Woodruff, 1985; Walker & Greene, 1989; Walker, Garber, & Greene, 1993), future research with FAP samples should examine further the nature of the indirect effects of neurocognitive variables on anxiety through different approaches to coping.

Contrary to hypotheses, coping did not predict caregiver-reported symptoms of depression. This null finding may be related to the very low levels of depression and the little variability in this outcome variable. Future research should examine self-reported symptoms of depression when examining the role of coping in psychological outcomes of children with FAP to determine if this finding is a function of the information source.

Another secondary aim was to document the relations between pain catastrophizing and outcomes of interest in a pediatric pain sample. Also contrary to hypotheses and previous studies in adults and children (Crombez et al., 2003; Vervoort et al., 2006), pain catastrophizing was not significantly related to levels of pain, functional disability, or anxiety. The lack of a significant relation between pain catastrophizing and these variables is particularly surprising given the strength of the relations between these variables documented in a previous study. In a sample of 43 children and adolescents with a chronic and recurrent pain condition referred for a psychological evaluation of their pain complaints, Crombez and colleagues (Crombez et al., 2003; Vervoort et al., 2006) found correlations of .49 ($p < .001$) and .50 ($p < .001$) between pain catastrophizing and pain intensity and functional disability respectively. Given that the pain complaints comprising the sample in this study consisted largely but not entirely of abdominal pain ($n = 18$), it could be that the relations between pain catastrophizing and these variables were different in the other pain conditions that made up the sample than in the sample of the present study. Future studies exploring the influence of pain catastrophizing should distinguish between pain groups to determine if the relations between these variables are unique to specific chronic and episodic pain conditions or are generalizable across pediatric pain conditions.

Another potential reason for the different findings between the current sample and the sample from Crombez and colleagues (2003; Vervoort et al., 2006) study is the source of recruitment. Patients from a tertiary specialty practice for gastroenterological problems comprised the current sample, whereas the sample from the published study consisted of patients from a child psychiatric unit who were referred for a psychological evaluation of their pain problems. The relation between pain catastrophizing and pain problems is likely to be stronger in children requiring psychiatric evaluation and intervention due to the presumed increased severity of the pain problems in that sample than in children seeking medical care from a tertiary medical center.

It also is possible that the current study did not have enough power to detect potential small but meaningful relations between pain catastrophizing and the variables of interest. In particular, the positive but weak relation between pain catastrophizing and abdominal pain problems ($r = .19$, $p = .21$) may have been stronger with a larger sample size.

Exploratory analyses revealed significant relations between pain catastrophizing and levels of appraised stress, performance on sustained attention tasks, and use of primary control coping strategies. Participants who engaged in more pain catastrophizing viewed the episodes of abdominal pain as more stressful. Although the cross-sectional nature of the study prevents inference about causality, this result highlights a general area for intervention in children with functional abdominal pain by addressing children's tendencies to exaggerate the potential consequences of pain.

Higher levels of pain catastrophizing also were related to poorer performance on sustained attention tasks. This result is consistent with a previous study that found higher rates of catastrophic thinking about pain was related to greater attentional interference during a tone discrimination task when presented with threats for an electrocutaneous stimulus (Crombez et al., 1998). The current finding appears driven by the relations between poorer sustained attention and increased levels of magnification of pain sensations and feelings of helplessness when in pain. These cognitive patterns when experiencing pain may disrupt the ability to concentrate and allocate attention over time. Given the importance of sustained attention in many daily functions, these cognitions may be important variables to target in interventions in order to improve the quality of life in children and adolescents with chronic pain.

Finally, increased rates of pain catastrophizing were related to a tendency to use less primary control coping strategies during a pain episode. This relation appears to be driven by the magnification aspects of pain catastrophizing as well, suggesting that children who amplify their difficulties with pain also tend to take steps to change the situation less frequently.

A notable, secondary finding that emerged from this study was the significant correlation between caregiver-identified levels of executive function on the BRIEF and participants' performance on subtests of the TEA-Ch measuring sustained attention. This suggests that caregivers' perceptions of their children's EF abilities are similar to their children's actual performance on a well-normed, standardized measure of attention and underscores the issue of ecological validity in neuropsychological testing with children. Traditional neuropsychological tests only measure components of EF over short periods of time in well-structured settings and may fail to capture children's EF performance under the demands of real-world settings (Anderson et al., 2002; Gioia & Isquith, 2004). Highlighting this lack of ecological validity is evidence that suggests performance on standardized neuropsychological tests of EF are weakly related to EF in everyday activities (Dennis, Guger, Roncadin, Barnes, & Schachar, 2001; Silver, 2000). The BRIEF was developed to address the issue of ecological validity in measuring EF by assessing the everyday, behavioral aspects of EF yet the few studies that have compared the BRIEF index scores with traditional neuropsychological measures of EF show mixed relations (Anderson et al., 2002; Mangeot et al., 2002; Vriezen & Pigott, 2002). The current finding supports the use of the BRIEF as a measure of EF in children's home environments.

The current study is the first of its nature in a pediatric pain sample and had a number of strengths. First, as previously noted, this study's methodology employed well-normed measures of EF and attention regulation that capture these abilities from multiple perspectives including performance-based measures of EF and caregiver report of behavior. Second, the use of bootstrapping procedures for mediation offered advantages over the traditional Baron and Kenny

(1986) approach to mediation and the conservative Sobel (1982) test and provided the best opportunity to detect mediation effects in a smaller sample. Future studies should consider bootstrapping procedures when examining potential mediation effects.

Finally, this exploratory investigation provided a framework for future examinations of the influence of children's EF and attention regulation abilities on children's coping in a variety of pediatric populations. Since children with medical conditions vary in terms of their EF and attention regulation abilities, often as a result of their disease and treatment (e.g., cancer, sickle cell disease, chronic kidney disease, epilepsy), it will be important to determine how much these abilities influence the choice and success of coping strategies in different illness groups. This investigation serves as a model for subsequent studies that can be expanded upon to include comparisons between illness groups.

While this study focused on pain and functional disability as outcomes, the framework from this study can be used with a variety of populations and outcomes of interest. For example, studies might examine whether neurocognitive abilities indirectly influence important outcomes like medication adherence in children with epilepsy through the ability to establish routines or whether they affect social relationships through the identification of social cues in children with brain tumors. In addition, this framework can be used in conjunction with intervention studies to determine if EF and attention regulation abilities mediate the relation between exposure to a cognitive-behavioral intervention and actual implementation of the skills upon completion of the treatment. This type of study may aid in identifying children who need more frequent or modified exposure to an intervention.

Research using the framework from this study in other pediatric populations, including other pain populations, may address the issue of the generalizability of the current results. It is unclear whether these findings, particularly the relations between selective attention, coping, and anxiety, are specific to children diagnosed with FAP or are applicable to other groups. Perhaps it is the unpredictable, episodic nature of the pain in children with FAP that influences the development of the particular patterns of attention and coping seen in this sample. Additional studies in children with more stable chronic pain conditions or other pediatric chronic illnesses (e.g., diabetes) are needed to explore such questions.

This study had limitations that may have impacted the findings and should be considered when interpreting the results. Most notably, the sample size of 44 participants limited the ability to detect small but potentially meaningful relations between the variables. In particular, with a larger sample analyses with attentional control predicting secondary control coping, disengagement coping, and functional disability may have been significant and the relation between secondary control coping and functional disability may have been stronger. Although the only published study using this framework for investigating the effects of EF and attention regulation found significant results with a sample size of 30 (Campbell et al., 2009), it is possible that more participants in the present sample may have illuminated effects that were not detected.

The recruitment of the present sample was affected by the low clinic appointment attendance rates of children diagnosed with functional abdominal pain. Approximately 80 children diagnosed with functional abdominal pain were identified as potential participants for this study but did not attend their scheduled appointment. One potential reason for the poor attendance of scheduled appointments is the nature of the medical treatment following diagnosis. Medical treatment of FAP usually consists of reassurance about the absence of an organic disease (Edwards, Mullins, Johnson, & Bernardy, 1994) and often does not include medications.

It is possible that a large percentage of the families of potential participants chose not to attend their appointment due to the typical approach for managing FAP.

Another potential limitation is that this study did not assess EF and attention regulation abilities during pain episodes. Pain disrupts normal attentional processes and demands attentional resources (Eccleston & Crombez, 1999) and it is a child's EF and attention regulation abilities when in pain that will primarily influence the type and quality of coping attempt during a pain episode. Although participants' ratings of their pain level at the time of data collection were not correlated with their performance on the tests of attention regulation, these measures may not have accurately captured these attention regulation abilities during a true pain episode. Children's ability to regulate their attention on these tasks may have been qualitatively different than their ability to regulate their attention while experiencing significant pain. There is likely greater variability in EF and attention regulation across individuals with FAP during a pain episode and it is this variability and its influence on coping that is of primary interest. To address this limitation, future research exploring these relations could employ experimental methods and procedures such as the water load symptom provocation test, which creates sensations similar to those experienced during abdominal pain episodes in children with FAP (Walker et al., 2006). Such procedures could stimulate low levels of abdominal discomfort in children with FAP in a laboratory setting and use well-normed, performance-based measures of EF and attention regulation. This method could be used to examine relations between EF and attention regulation during pain episodes and coping strategies generally used during pain episodes.

In addition, this method could compare performance on neuropsychological tests of EF and attention regulation in children with FAP both in the presence and absence of abdominal pain symptoms to determine the extent to which children with FAP vary in terms of their attention regulation abilities depending on the presence of pain. Such variability could then be compared to healthy controls' EF and attention regulation performance both in the presence and absence of pain to determine if this variability in EF and attention regulation uniquely contributes to the difficulties experienced in children with FAP.

Similarly, this study relied on retrospective recall of the coping strategies used during abdominal pain episodes and may not have accurately assessed coping during these pain episodes. Future research examining the role of coping and its relation with EF, attention regulation, and identified outcomes in children with FAP should consider using daily diary methods (e.g., Walker et al., 2007) or ecological momentary assessment approaches(e.g., Barrett & Barrett, 2001) to measure coping closer to the occurrence of an abdominal pain episode.

Overall, the findings from this exploratory study indicate notable relations between attention regulation variables and approaches to coping in children with FAP. Attention regulation and coping may be important factors that contribute to the variability in outcomes in children with FAP and are worthy of future research. This study is an introductory investigation into these variables in a pediatric pain condition and provides a foundation for future studies.

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FOOTNOTES

[1]T-tests examined potential differences on notable variables between children based on the presence or absence of an anxiety disorder diagnosis, an ADHD diagnosis, and medication to treat ADHD. Children with a previously diagnosed anxiety disorder (n = 8) had significantly higher levels of functional disability (M = 31.5, SD = 14.09) than those without an anxiety disorder diagnosis (M = 12.83, SD = 9.82; t[42] = 4.48, p < .01). Children with a previously diagnosed anxiety disorder also employed less secondary control coping strategies (M = 0.89, SD = .40) than children without an anxiety disorder diagnosis (M = 1.43, SD = .555; t[42] = -2.63, p < .05). A diagnosed anxiety disorder was not included as a covariate in the analyses predicting functional disability and secondary control coping presented in this study due to the small number of children with an anxiety disorder in the sample and because the presence of this variable did not impact the results.

Caregivers of children diagnosed with ADHD (n = 10) reported significantly more difficulties with EF on the BRIEF (M = 150.40, SD = 29.65) than children without an ADHD diagnosis (M = 125.00, SD = 26.33; t[42] = 2.61, p < .05). Children with an ADHD diagnosis also performed worse on subtests of the TEA-Ch measuring attentional control (M = 4.05, SD = 2.82) than children not diagnosed with ADHD (M = 6.59, SD = 3.43; t[41] = -2.13, p < .05). Children taking medication for ADHD (n = 6) reported significantly less use of disengagement coping strategies (M = 1.11, SD = .42) than children not taking medication for ADHD (M = 1.60, SD = .52; t[42] = -2.19, p < .05). Taking medications to treat ADHD also was not included as a covariate in the analyses predicting disengagement coping presented in the results due to the small number of children taking medication for ADHD in the sample and because the presence of this variable did not impact the results.

Table 1

Caregiver-reported Characteristics of Sample

Variables	Range	Mean (*SD*)
Abdominal pain episodes in past year	5 – 365	32.25 (62.81)
Months since onset of abdominal pain episodes	1 – 109	31.16 (27.73)
Missed school days in past year	1 – 60	13.78 (14.04)
Doctor visits in past year for abdominal pain	1 – 50	7.95 (8.20)

Table 2

Correlations Between TEA-Ch Subtest Performance and Derived Attention Variables

Variables	2	3	4	5	6	7	8
1. Sky Search Attention score	.44**	.29	.01	.34*	1.0	.16	.43**
2. Creature Counting Timing score	-	.36*	.43**	.71**	.44**	.48**	.95**
3. Sky Search DT score	-	-	.39*	.37*	.29	.80**	.39*
4. Score DT score	-	-	-	.43**	.01	.87**	.46**
5. Opposite World score	-	-	-	-	.34*	.48**	.90**
6. Selective Attention	-	-	-	-	-	.16	.43**
7. Sustained Attention	-	-	-	-	-	-	.52**
8. Attentional Control	-	-	-	-	-	-	-

Note: Attentional Control = Average of Creature Counting Timing score and Opposite World score; Selective Attention = Sky Search Attention score; Sustained Attention = Average of Sky Search DT score and Score DT score.

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

Table 3

Correlations Between Subscales and Composite Scales on the BRIEF

Variables	2	3	4	5	6	7	8	9	10	11
1. GEC	.97**	.99**	.82**	.66**	.81**	.88**	.82**	.91**	.67**	.87**
2. BRI	-	.92**	.90**	.76**	.92**	.71**	.62**	.72**	.49**	.72**
3. MI	-	-	.70**	.53**	.66**	.90**	.87**	.94**	.72**	.88**
4. Inhibit	-	-	-	.60**	.77**	.62**	.61**	.67**	.44**	.67**
5. Shift	-	-	-	-	.55**	.51**	.47**	.56**	.26	.42**
6. EC	-	-	-	-	-	.65**	.49**	.61**	.45**	.69**
7. Initiate	-	-	-	-	-	-	.69**	.78**	.69**	.79**
8. WM	-	-	-	-	-	-	-	.80**	.47**	.67**
9. P/O	-	-	-	-	-	-	-	-	.56**	.81**
10. OM	-	-	-	-	-	-	-	-	-	.55**
11. Monitor	-	-	-	-	-	-	-	-	-	-

BRI: Behavioral Regulation Index; EC: Emotional Control; GEC: Global Executive Composite; MI: Metacognition Index; OM: Organization of Materials; P/O: Plan/Organize; WM: Working Memory.

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

Table 4

Mean Scores for the Abdominal Pain Index Responses by Age Group

	Age 8-10	Age 11-13	Age 14-16
	(*n* = 17)	(*n* = 16)	(*n* = 11)
Item	Mean (*SD*)	Mean (*SD*)	Mean (*SD*)
Frequency of pain	2.59 (1.54)	2.56 (1.79)	2.18 (1.83)
Number of episodes per day	2.00 (1.58)	2.13 (1.71)	2.18 (1.72)
Duration of pain episode	2.88 (1.99)	3.93 (2.86)	3.09 (2.88)
Typical pain intensity	5.17 (1.77)	5.75 (2.88)	5.27 (3.10)
Maximum pain intensity	7.00 (1.92)	6.37 (2.47)	5.81 (2.78)

Table 5

Mean Scores for Primary Variables

Variables	Range	Mean (*SD*)
BRIEF Global Executive Composite *T* score	37-85	58.20 (11.99)
Selective Attention standard score	1-18	8.23 (3.20)
Sustained Attention average standard score	1-11.5	6.70 (2.85)
Attentional Control average standard score	0.5-12.5	6.00 (3.44)
Voluntary Primary Control Coping	0.22-2.89	1.53 (.61)
Voluntary Secondary Control Coping	0.22-2.33	1.34 (.57)
Voluntary Disengagement Coping	0.42-2.83	1.53 (.53)
Involuntary Engagement Responses	0-2.07	1.01 (.55)
Involuntary Disengagement Responses	0.5-2.17	1.34 (.60)
Abdominal Pain Index	-1.78-1.45	.00 (.76)
Functional Disability Inventory	0-60	16.22 (12.81)
MASC-10 score	2-24	14.73 (5.91)
BASC-2 Depression average item score	0.07-2.43	.95 (.52)
Pain Catastrophizing Scale score	10-51	25.25 (10.68)

BASC-2: Behavior Assessment System for Children, Second Edition; BRIEF: Behavior Rating Inventory of Executive Function; MASC-10: Multidimensional Anxiety Scale for Children – 10-item form; TEA-Ch: Test of Everyday Attention for Children.

Table 6

Correlations Between Primary Variables

Variables	2	3	4	5	6	7	8	9	10	11	12
1. BRIEF	-.14	-.50**	-.24	.04[a]	.12	-.18	.01	.08	.13	.57**	.25
2. SelAtt	-	.16	.43**	-.03	.33*	.39**	.17	-.10	-.22	-.02	-.21
3. SusAtt	-	-	.52**	.04	-.07	.17	.06	-.18	.18	-.47**	-.32*
4. AC	-	-	-	-.06	.25	.25	-.09	-.28	-.09	-.18	-.29
5. PCC	-	-	-	-	-.19	-.01	-.08	.16	.09	-.06	-.30*
6. SCC	-	-	-	-	-	.17	.16	-.27	-.41**	-.09	-.17
7. DC	-	-	-	-	-	-	.20	-.01	-.15	-.17	-.06
8. API	-	-	-	-	-	-	-	.08	.13	-.08	.19
9. FDI	-	-	-	-	-	-	-	-	.10	.19	.01
10. MASC10	-	-	-	-	-	-	-	-	-	.19	-.01
11. BASC-2D	-	-	-	-	-	-	-	-	-	-	.14
12. PCS	-	-	-	-	-	-	-	-	-	-	-

AC: Attentional Control; API: Abdominal Pain Index score; BASC-2D: Behavior Assessment System for Children, Second Edition – Depression; BRIEF: Behavior Rating Inventory of Executive Function Global Executive Composite raw scores; DC: Disengagement Coping; FDI: Functional Disability Inventory; MASC-10: Multidimensional Anxiety Scale for Children – 10-item form; PCC: Primary Control Coping; PCS: Pain Catastrophizing Scale; SCC: Secondary Control Coping; SelAtt: Selective Attention; SusAtt: Sustained Attention.

[a]Proportional scores were used for the correlations with RSQ factors (PCC, SCC, and DC).

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

Table 7

Correlations Between Coping Factors on the RSQ

Variables	2	3	4	5	6	7	8
1. Positive Thinking	.18[a]	.23	.08	.47***	-.10	.28*	.15
2. Cognitive Restructuring	-	.15	-.03	.20	-.32**	-.03	-.03
3. Acceptance	-	-	-.06	-.06	.16	.19	.48***
4. Avoidance	-	-	-	.26*	-.20	-.08	.06
5. Denial	-	-	-	-	-.16	.13	.11
6. Wishful Thinking	-	-	-	-	-	.11	.40***
7. Distraction	-	-	-	-	-	-	.16
8. Selective Attention	-	-	-	-	-	-	-

[a]Proportional scores for the RSQ factors were used for the correlations.

* p <.09. **p < .05 . ***p <.01.

Table 8

Regression Analyses for Executive Function and Attention Regulation Variables Predicting Primary Control Coping

Variables	β	Beta	*t*	R^2	Cohen's f^2
I. Outcome: Primary Control Coping[a]					
BRIEF GEC score	.00	-.06	-0.41	.01	.01
Selective Attention	.00	-.04	-0.23		
II. Outcome: Primary Control Coping					
BRIEF GEC score	.00	-.06	-0.31	.00	.00
Sustained Attention	.00	.01	0.05		
III. Outcome: Primary Control Coping					
BRIEF GEC score	.00	-.08	-0.48	.01	.01
Attentional Control	.00	-.08	-0.47		

BRIEF GEC: Behavior Rating Inventory of Executive Function Global Executive Composite.

Cohen's f^2 of .02, .15, and .35 considered small, medium, and large, respectively (Cohen, 1988).

[a]Proportional scores were used for the RSQ factors.

Table 9

Regression Analyses for Executive Function and Attention Regulation Variables Predicting Secondary Control Coping

Variables	β	Beta	*t*	R^2	Cohen's f^2
I. Outcome: Secondary Control Coping[a]					
BRIEF GEC score	.00	.18	1.24	.14**	.16
Selective Attention	.01	.36	2.42**		
II. Outcome: Secondary Control Coping					
BRIEF GEC score	.00	.13	0.72	.02	.02
Sustained Attention	.00	-.01	-0.03		
III. Outcome: Secondary Control Coping					
BRIEF GEC score	.00	.20	1.31	.10	.11
Attentional Control	.01	.29	1.91*		

BRIEF GEC: Behavior Rating Inventory of Executive Function Global Executive Composite.

Cohen's f^2 of .02, .15, and .35 considered small, medium, and large, respectively (Cohen, 1988).

[a]Proportional scores were used for the RSQ factors.

**p* = .06; ***p* < .05.

Table 10

Regression Analyses for Executive Function and Attention Regulation Variables Predicting Disengagement Coping

Variables	β	Beta	*t*	R^2	Cohen's f^2
I. Outcome: Disengagement Coping[a]					
BRIEF GEC score	.00	-.14	-0.99	.18*	.18
Selective Attention	.01	-.37	2.58*		
II. Outcome: Disengagement Control Coping					
BRIEF GEC score	.00	-.15	-0.86	.05	.05
Sustained Attention	.00	.09	0.50		
III. Outcome: Disengagement Control Coping					
BRIEF GEC score	.00	-.15	-0.94	.08	.09
Attentional Control	.00	.21	1.34		

BRIEF GEC: Behavior Rating Inventory of Executive Function Global Executive Composite.

Cohen's f^2 of .02, .15, and .35 considered small, medium, and large, respectively (Cohen, 1988).

[a]Proportional scores were used for the RSQ factors.

*$p < .05$.

Table 11

Regression Analyses for Variables Predicting Abdominal Pain Complaints

Variables	β	Beta	*t*	R^2 Δ	Cohen's f^2
Step 1: Participant age	0.11	.32	2.24*	.22**	.28
Caregiver education	-0.21	-.31	-2.16*		
Model 1: Executive Function and Selective Attention					
Step 2: Participant age	0.10	.29	1.98	.02	.03
Caregiver education	-0.23	-.33	-2.28*		
BRIEF GEC score	0.00	-.04	-0.28		
Selective Attention	0.04	.15	0.99		
Model 2: Executive Function and Sustained Attention					
Step 2: Participant age	0.11	.32	2.21*	.03	.04
Caregiver education	-0.25	-.35	-2.39*		
BRIEF GEC score	0.00	.03	0.17		
Sustained Attention	0.05	.19	1.10		
Model 3: Executive Function and Attentional Control					
Step 2: Participant age	0.11	.33	2.26*	.01	.01
Caregiver education	-0.23	-.33	-2.19*		
BRIEF GEC score	0.00	-.05	-0.31		
Attentional Control	0.02	.08	0.48		

BRIEF GEC: Behavior Rating Inventory of Executive Function Global Executive Composite.

Cohen's f^2 of .02, .15, and .35 considered small, medium, and large, respectively (Cohen, 1988).

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

Table 12

Regression Analyses for Variables Predicting Functional Disability

Variables	β	Beta	t	R^2	Cohen's f^2
I. Executive Function and Selective Attention					
BRIEF GEC score	0.03	.07	0.44	.02	.02
Selective Attention	-0.37	-.09	-0.58		
II. Executive Function and Sustained Attention					
BRIEF GEC score	0.00	.00	-0.04	.03	.03
Sustained Attention	-0.83	-.18	-1.01		
III. Executive Function and Attentional Control					
BRIEF GEC score	0.01	.02	0.12	.08	.09
Attentional Control	-1.03	-.27	-1.74*		

BRIEF GEC: Behavior Rating Inventory of Executive Function Global Executive Composite.

Cohen's f^2 of .02, .15, and .35 considered small, medium, and large, respectively (Cohen, 1988).

*p = .09.

Table 13

The Indirect Effects of Executive Function on Abdominal Pain through Coping

		Bootstrapping[a]					
	Point	Percentile 95% CI		BC 95% CI		BCa 95% CI	
	Estimate	Lower	Upper	Lower	Upper	Lower	Upper
Model 1							
PCC	.0000	-.0007	.0022	-.0021	.0006	-.0028	.0005
Age	-.0001	-.0028	.0031	-.0029	.0028	-.0030	.0027
Caregiver Education	.0007	-.0019	.0046	-.0015	.0052	-.0013	.0058
Total	.0006	-.0030	.0062	-.0037	.0054	-.0036	.0055
Model 2							
SCC	.0004	-.0012	.0028	-.0004	.0045	-.0004	.0044
Age	-.0001	-.0024	.0028	-.0028	.0023	-.0030	.0023
Caregiver Education	.0007	-.0022	.0048	-.0018	.0056	-.0015	.0066
Total	.0011	-.0032	.0065	-.0031	.0067	-.0030	.0070

BC: bias corrected; BCa: bias corrected and accelerated; PCC: Primary Control Coping; SCC: Secondary Control Coping.

[a]5000 bootstrap samples.

Table 14

The Indirect Effects of Selective Attention on Abdominal Pain through Coping

	Point	Bootstrapping[a]					
		Percentile 95% CI		BC 95% CI		BCa 95% CI	
	Estimate	Lower	Upper	Lower	Upper	Lower	Upper
		Model 1					
PCC	.0007	-.0217	.0131	-.0116	.0241	-.0081	.0634
Age	.0128	-.0039	.0435	-.0022	.0491	-.0024	.0478
Caregiver Education	-.0093	-.0322	-.0209	-.0388	.0134	-.0405	.0119
Total	.0041	-.0334	.0442	-.0346	.0419	-.0356	.0407
		Model 2					
SCC	.0075	-.0190	.0378	-.0136	.0474	-.0137	.0468
Age	.0119	-.0039	.0418	-.0019	.0488	-.0024	.0467
Caregiver Education	-.0097	-.0349	.0218	-.0416	.0145	-.0430	.0130
Total	.0096	-.0342	.0625	-.0368	.0601	-.0399	.0574

BC: bias corrected; BCa: bias corrected and accelerated; PCC: Primary Control Coping; SCC: Secondary Control Coping.

[a]5000 bootstrap samples.

Table 15

The Indirect Effects of Sustained Attention on Abdominal Pain through Coping

		Bootstrapping[a]					
	Point	Percentile 95% CI		BC 95% CI		BCa 95% CI	
	Estimate	Lower	Upper	Lower	Upper	Lower	Upper
			Model 1				
PCC	-.0011	-.0163	.0123	-.0261	.0068	-.0261	.0069
Age	-.0026	-.0320	.0253	-.0352	.0222	-.0344	.0233
Caregiver Education	-.0266	-.0697	.0007	-.0760	-.0016	-.0777	-.0022
Total	-.0304	-.0799	.0128	-.0830	.0105	-.0830	.0104
			Model 2				
SCC	-.0028	-.0238	.0118	-.0358	.0063	-.0349	.0066
Age	-.0023	-.0300	.0217	-.0347	.0179	-.0327	.0188
Caregiver Education	-.0286	-.0755	.0002	-.0825	-.0017	-.0836	-.0019
Total	-.0337	-.0945	.0136	-.0986	.0114	-.0995	.0112

BC: bias corrected; BCa: bias corrected and accelerated; PCC: Primary Control Coping; SCC: Secondary Control Coping.

[a]5000 bootstrap samples.

Table 16

The Indirect Effects of Attentional Control on Abdominal Pain through Coping

	Point	Bootstrapping[a]					
		Percentile 95% CI		BC 95% CI		BCa 95% CI	
	Estimate	Lower	Upper	Lower	Upper	Lower	Upper
			Model 1				
PCC	.0013	-.0080	.0165	-.0057	.0209	-.0061	.0205
Age	-.0146	-.0378	.0091	-.0446	.0029	-.0434	.0035
Caregiver Education	-.0239	-.0538	.0023	-.0630	-.0038	-.0656	-.0044
Total	-.0371	-.0734	.0021	-.0878	-.0085	-.0890	-.0087
			Model 2				
SCC	.0064	-.0160	.0308	-.0070	.0428	-.0071	.0428
Age	-.0131	-.0345	.0078	-.0425	.0013	-.0405	.0019
Caregiver Education	-.0246	-.0538	.0007	-.0624	-.0039	-.0663	-.0049
Total	-.0313	-.0728	.0091	-.0822	.0024	-.0843	.0018

BC: bias corrected; BCa: bias corrected and accelerated; PCC: Primary Control Coping; SCC: Secondary Control Coping.

[a]5000 bootstrap samples.

Table 17

The Indirect Effects of Executive Function on Functional Disability through Coping

	Point Estimate	Bootstrapping[a] Percentile 95% CI Lower	Upper	BC 95% CI Lower	Upper	BCa 95% CI Lower	Upper
		Model 1					
PCC	.0025	-.0237	.0442	-.0205	.0533	-.0216	.0481
		Model 2					
SCC	-.0152	-.0612	.0260	-.0811	.0145	-.0896	.0121

BC: bias corrected; BCa: bias corrected and accelerated; PCC: Primary Control Coping; SCC: Secondary Control Coping.

[a]5000 bootstrap samples.

Table 18

The Indirect Effects of Selective Attention on Functional Disability through Coping

	Point	Bootstrapping[a]					
		Percentile 95% CI		BC 95% CI		BCa 95% CI	
	Estimate	Lower	Upper	Lower	Upper	Lower	Upper
		Model 1					
PCC	-.0197	-.4592	.3415	-.5408	.2846	-.6371	.2398
		Model 2					
SCC	-.3597	-1.1168	.0406	-1.2447	.0136	-1.1457	.0468

BC: bias corrected; BCa: bias corrected and accelerated; PCC: Primary Control Coping; SCC: Secondary Control Coping.

[a]5000 bootstrap samples.

Table 19

The Indirect Effects of Sustained Attention on Functional Disability through Coping

		Bootstrapping[a]					
	Point	Percentile 95% CI		BC 95% CI		BCa 95% CI	
	Estimate	Lower	Upper	Lower	Upper	Lower	Upper
			Model 1				
PCC	.0315	-.3252	.4313	-.2181	.5388	-.2333	.5226
			Model 2				
SCC	.0900	-.3036	.5236	-.2100	.6360	-.1917	.6567

BC: bias corrected; BCa: bias corrected and accelerated; PCC: Primary Control Coping; SCC: Secondary Control Coping.

[a]5000 bootstrap samples.

Table 20

The Indirect Effects of Attentional Control on Functional Disability through Coping

	Point	Bootstrapping[a]					
		Percentile 95% CI		BC 95% CI		BCa 95% CI	
	Estimate	Lower	Upper	Lower	Upper	Lower	Upper
		Model 1					
PCC	-.0356	-.2763	.2797	-.4103	.1298	-.4442	.1212
		Model 2					
SCC	-.2015	-.7935	.0630	-.9160	.0274	-.8542	.0411

BC: bias corrected; BCa: bias corrected and accelerated; PCC: Primary Control Coping; SCC: Secondary Control Coping.

[a]5000 bootstrap samples.

Table 21

Regression Analyses for Coping Predicting Symptoms of Anxiety and Depression

Variables	β	Beta	*t*	R^2	Cohen's f^2
I. Outcome: Self-reported Anxiety					
Primary Control Coping[a]	0.81	.01	0.07	.18*	.22
Secondary Control Coping	-38.30	-.39	-2.66*		
Disengagement Coping	-8.97	-.09	-0.60		
II. Outcome: Parent-reported Depression					
Primary Control Coping	-0.56	-.07	-0.47	.04	.04
Secondary Control Coping	-0.68	-.08	-0.49		
Disengagement Coping	-1.39	-.15	-0.97		

Cohen's f^2 of .02, .15, and .35 considered small, medium, and large, respectively (Cohen, 1988).

[a]Proportional scores were used for the RSQ factors.

*$p < .05$.

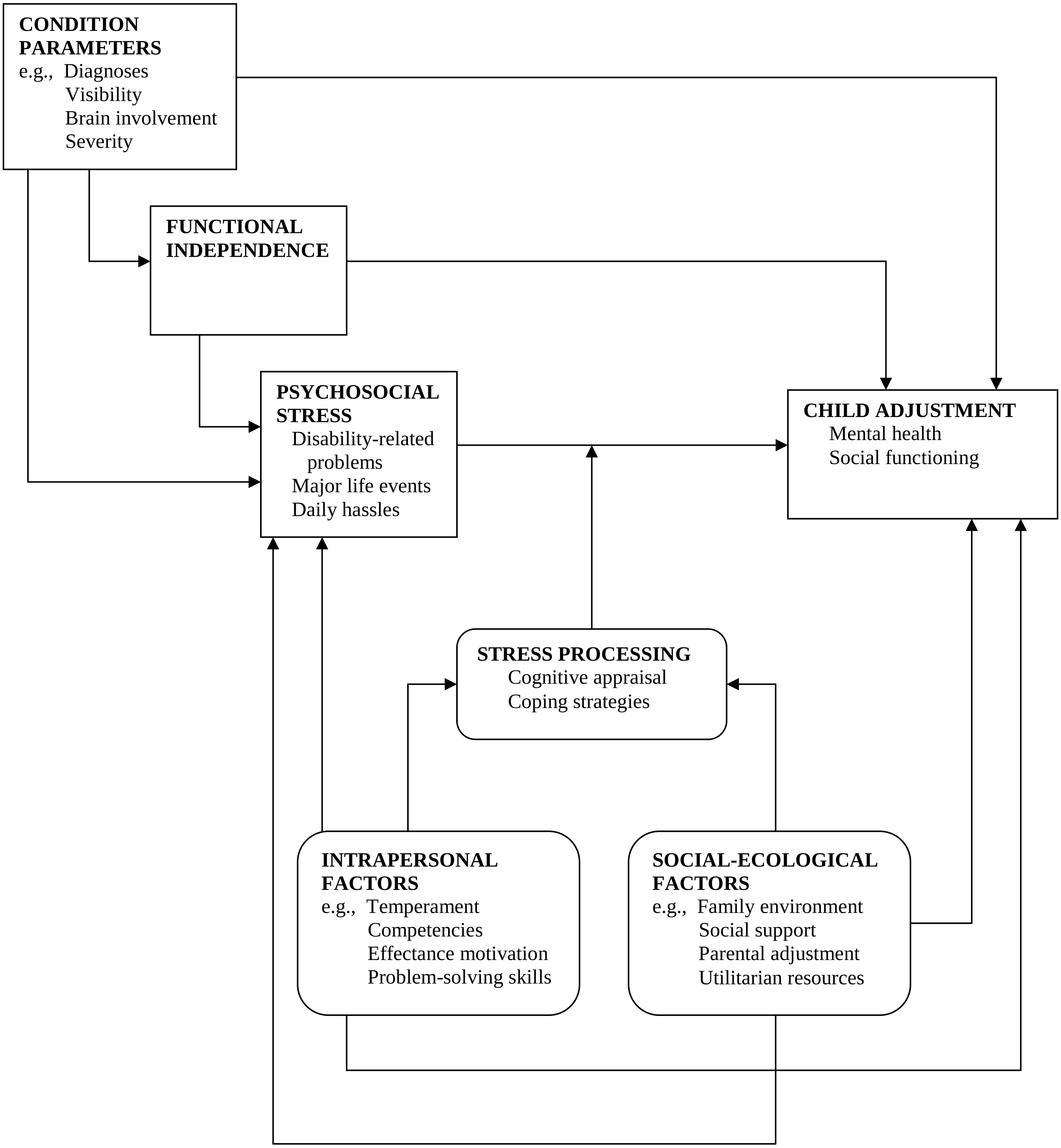
Table 22

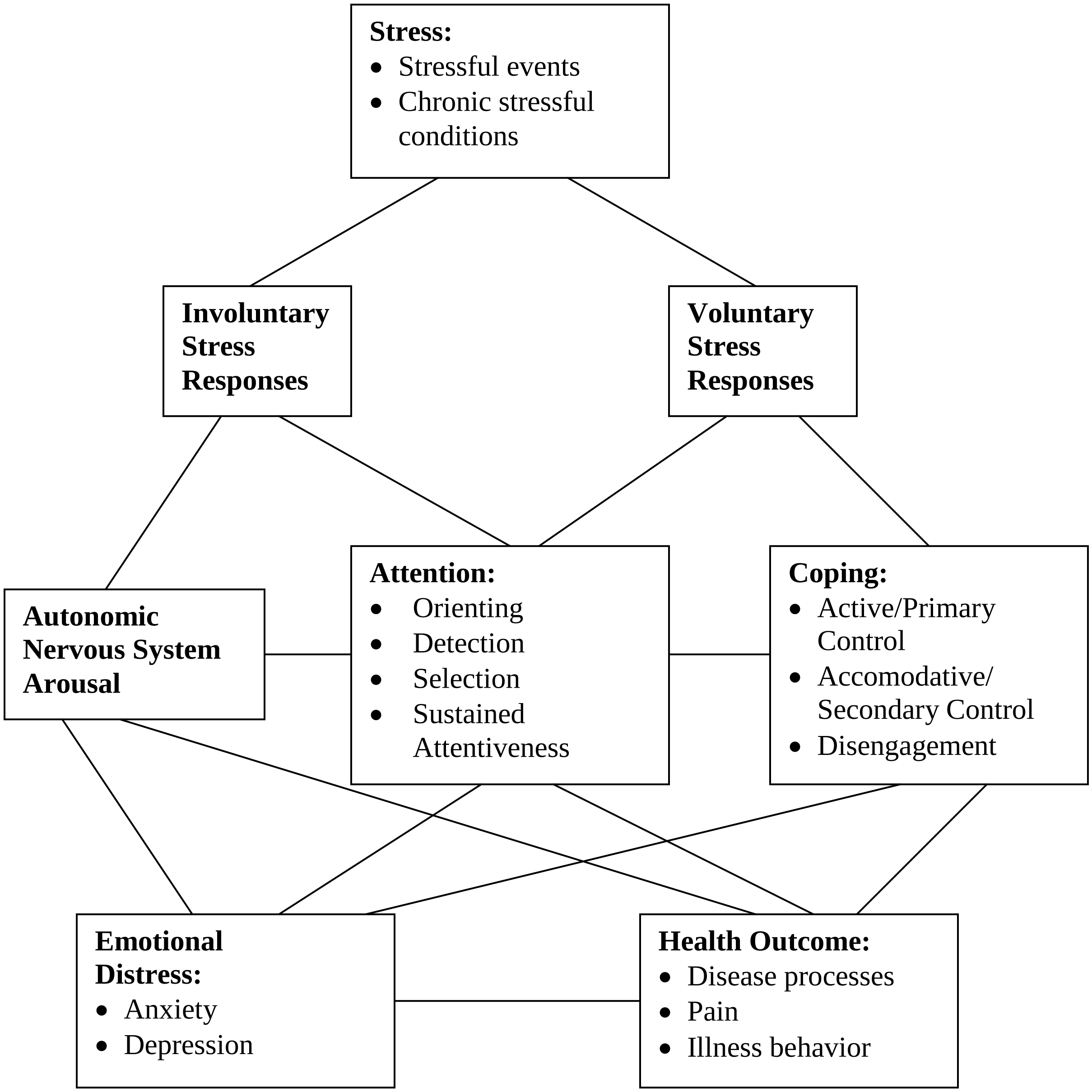
Indirect Effects of Selective Attention on Anxiety through Secondary Control Coping

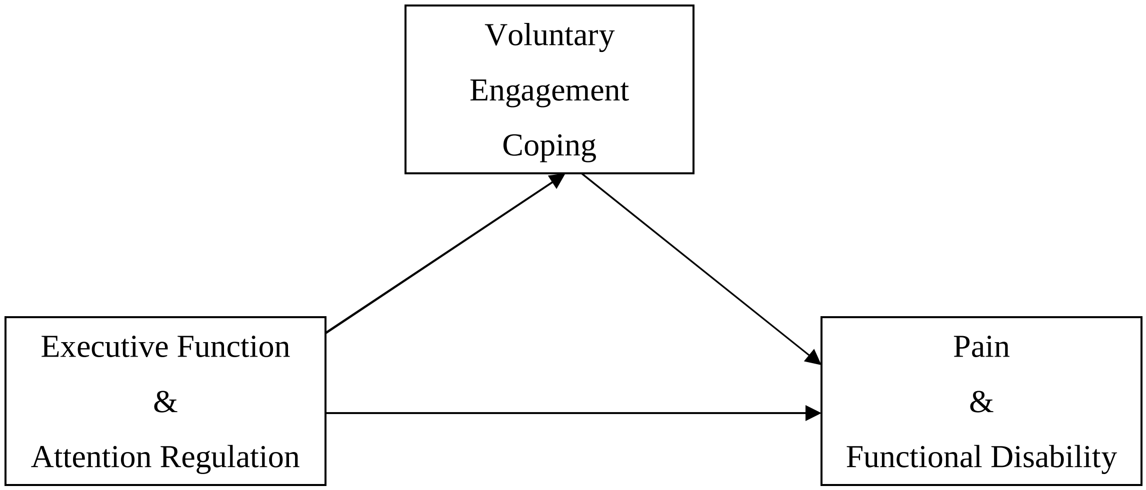
	Point	Bootstrapping[a]					
		Percentile 95% CI		BC 95% CI		BCa 95% CI	
	Estimate	Lower	Upper	Lower	Upper	Lower	Upper
SCC	-.2316	-.5649	-.0058	-.6334	-.0387	-.6209	-.0369

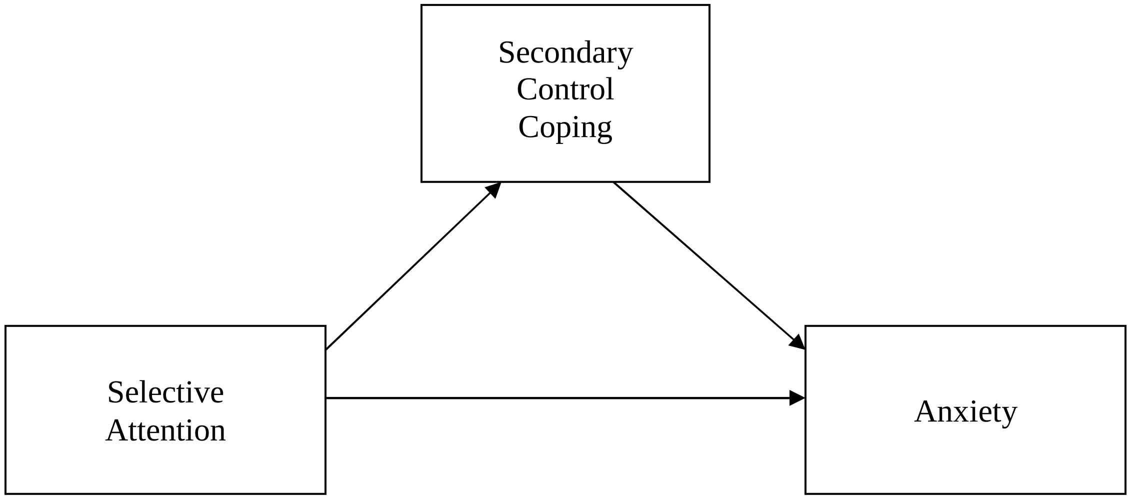
BC: bias corrected; BCa: bias corrected and accelerated; SCC: Secondary Control Coping.

[a]5000 bootstrap samples.


CONDITION PARAMETERS
e.g., Diagnoses
Visibility
Brain involvement
Severity
FUNCTIONAL INDEPENDENCE
PSYCHOSOCIAL STRESS
Disability-related problems
Major life events
Daily hassles
CHILD ADJUSTMENT
Mental health
Social functioning
STRESS PROCESSING
Cognitive appraisal
Coping strategies
INTRAPERSONAL FACTORS
e.g., Temperament
Competencies
Effectance motivation
Problem-solving skills
SOCIAL-ECOLOGICAL FACTORS
e.g., Family environment
Social support
Parental adjustment
Utilitarian resources


Stress:
• Stressful events
• Chronic stressful conditions
Involuntary Stress Responses
Voluntary Stress Responses
Autonomic Nervous System Arousal
Attention:
• Orienting
• Detection
• Selection
• Sustained Attentiveness
Coping:
• Active/Primary Control
• Accomodative/ Secondary Control
• Disengagement
Emotional Distress:
• Anxiety
• Depression
Health Outcome:
• Disease processes
• Pain
• Illness behavior


Voluntary
Engagement
Coping
Executive Function
&
Attention Regulation
Pain
&
Functional Disability


Secondary
Control
Coping
Selective
Attention
Anxiety

Appendix A

RESPONSES TO STRESS FORM

All kids get stomach aches, but some kids get them more often than others. So that we can find out more about your stomach aches and how stressful they were for you, please answer the next two questions thinking about the **last year**.

(1) Circle the letter that shows how often you usually got stomach aches:

a. once every few months
b. once a month
c. once a week
d. several times a week
e.once a day or more

(2) Circle the number that shows how stressful, or how much of a hassle your stomach aches were for you**.**

1	2	3	4
Not at all	A little	Somewhat	Very

This is a list of things that kids sometimes do, think, or feel when they are trying to deal with stomach aches. Everybody deals with stomach aches in their own way - some children or teens do a lot of the things on this list or have a bunch of feelings, other people just do or think a few things.

Think of when you have a stomach ache. For each item on the list below, circle **one** number from 1 (not at all) to 4 (a lot) that shows **how much** you do or feel these things when you have a stomach ache. Please let us know about everything you do, think, and feel, even if you don't think it helps make things better.

How much do you do this?

	Not at all	A little	Some	A lot
1. I **try** not to have any emotions.	1	2	3	4
2. Just thinking about stomach aches makes my stomach feel funny and gives me a Headache.	1	2	3	4
3. I try to think of different ways to make my stomach ache feel better or go away. **Write one plan you thought of** :____________________________________ ____	1	2	3	4
4. When I get a stomach ache, I don't feel any emotions at all, it's like I have no Feelings	1	2	3	4
5. I wish that I were stronger and less sensitive so that things would be different.	1	2	3	4
6. I **keep remembering** what it feels like to have a stomach ache or **can't stop thinking** when I might have one again.	1	2	3	4
7. I let someone or something know about my emotions or feelings. (Remember to circle a number.) --------------------------→	1	2	3	4

Check all you talked to:

Parent ☐ Friend ☐ Brother/Sister ☐ Pet ☐ Doctor/Nurse ☐
Teacher ☐ God ☐ Stuffed Animal ☐ None of these ☐

8. I decide I am okay the way I am, even though I get stomach aches a lot.	1	2	3	4
9. When I am around other people I act like I feel fine.	1	2	3	4

10. I just **have** to get away from everyone when I have stomach aches; I can't stop myself. 1 2 3 4

11. I deal with my stomach aches by wishing they would just go away, that everything would work itself out. 1 2 3 4

12. I get really jumpy when I have a stomach ache. 1 2 3 4

13. I realize that I just have to live with things the way they are. 1 2 3 4

14. When I get stomach aches, I just **can't** be near anything that reminds me of feeling sick. 1 2 3 4

15. I try not to think about my stomach ache, to forget all about it. 1 2 3 4

16. When I get stomach aches, I really don't know what my emotions are. 1 2 3 4

17. I ask other people for help or for ideas about how to make myself feel better.
(Remember to circle a number.) -------------------------→ 1 2 3 4

Check all you talked to:
Parent ☐ Friend ☐ Brother/sister ☐ Doctor/Nurse ☐
Teacher ☐ God ☐ None of these ☐

18. When I am having a stomach ache, I **can't stop** thinking about it when I try to sleep, or I have bad dreams about them. 1 2 3 4

19. I tell myself that I can get through this, or that I will do better next time. 1 2 3 4

20. I let my emotions out. (Remember to circle a number.) ---- ---→ 1 2 3 4

I do this by: (Check all that you did.)
Writing in a journal/diary ☐ Drawing/painting ☐
Complaining to let off steam ☐ Being sarcastic/making fun ☐
Listening to music ☐ Punching a pillow ☐
Exercising ☐ Yelling ☐
Crying ☐ None of these ☐

21. I get help from other people when trying to figure out how to deal with my emotions. -----→ 1 2 3 4

Check all that you went to:
Parent ☐ Friend ☐ Brother/sister ☐ Pet ☐
Teacher ☐ God ☐ Stuffed animal ☐ None of these ☐ Doctor/Nurse ☐

22. I **just can't** get myself to face the fact that I have a stomach ache. 1 2 3 4

23. I wish that someone would just come and make my stomach feel better. 1 2 3 4

24. I do something to try to fix my stomach ache or take action to change things. 1 2 3 4
Write one thing you did:____
____

25. Thoughts about getting stomach aches just pop into my head. 1 2 3 4

26. When I have stomachaches, I feel it in other places in my body. (Remember to circle a number.) ---- 1 2 3 4

Check all that happen:
My heart races ☐ My breathing speeds up ☐
I feel hot or sweaty ☐ My muscles get tight ☐
None of these ☐

You're half done! Remember to answer these questions thinking about how you feel when you have a stomach ache.

27. I **try** to stay away from people and things that make me feel upset or remind me of stomach aches. 1 2 3 4

28. I don't feel like myself when I have stomach aches, it's like I'm far away from everything. 1 2 3 4

29. I just take things as they are, I go with the flow. 1 2 3 4

30. I think about happy things to take my mind off my stomach ache or my emotions. 1 2 3 4

31. When I get stomach aches, I **can't stop** thinking about how I am **feeling**. 1 2 3 4

32. I get sympathy, understanding, or support from someone. (Remember to circle a number.) --------------→ 1 2 3 4
Check all you went to:
Parent ☐ Friend ☐ Brother/sister ☐ Teacher ☐
Doctor/Nurse ☐ None of these ☐

33. When I get stomach aches, I **can't** always control what I do. -------------------------→ (Remember to circle a number.) 1 2 3 4
Check all that happen:
I can't stop eating ☐ I can't stop talking ☐
I do dangerous things ☐ I have to keep fixing/checking things ☐
None of these ☐

34. I tell myself that things could be worse. 1 2 3 4

35. My mind just goes blank when I have a stomach ache, I can't think at all. 1 2 3 4

36. I tell myself that it doesn't matter, that it isn't a big deal. 1 2 3 4

37. When I have a stomach ache, right away I feel really: **(Check all you feel.)**
Angry ☐ Sad ☐ Scared ☐ Worried/anxious ☐ ---------------------------→ (Remember to circle a number.) 1 2 3 4
None of these ☐

38. It's really hard for me to concentrate or pay attention when I have a stomach ache. 1 2 3 4

39. I think about the things I'm learning from the situation, or something good that will come from it. 1 2 3 4

40. After I have a stomach ache, I **can't stop** thinking about how I felt. 1 2 3 4

41. When I get a stomach ache, I say to myself, "This isn't real." 1 2 3 4

42. When I have a stomach ache, I end up just lying around or sleeping a lot. 1 2 3 4

43. I keep my mind off my stomach ache by: (Remember to circle a number.) ---------------→ 1 2 3 4
Check all that you do:
Exercising ☐ Seeing friends ☐ Watching TV ☐
Playing video games ☐ Doing a hobby ☐ None of these ☐

44. When I have a stomach ache, I get upset by things that don't usually bother me. 1 2 3 4

45. I do something to calm myself down when I have a stomach ache. -----------------→ (Remember to circle a number.) 1 2 3 4
Check all that you do:
Take deep breaths ☐ Pray ☐ Walk ☐
Listen to music ☐ Take a break ☐ Meditate ☐ None of these ☐

46. I just freeze when I have a stomach ache, I **can't** do anything.	1	2	3	4
47. When I have a stomach ache, sometimes I act without thinking.	1	2	3	4
48. I keep my feelings under control when I have to, then let them out when they won't make things worse.	1	2	3	4
49. When I have a stomach ache, I can't seem to get around to doing things I'm supposed to do.	1	2	3	4
50. I tell myself that everything will be all right.	1	2	3	4
51. When I have a stomach ache, I **can't stop** thinking about **why** I get stomach aches.	1	2	3	4
52. I think of ways to laugh about my stomach ache so that it won't seem so bad.	1	2	3	4
53. My thoughts start racing when I have a stomach ache.	1	2	3	4
54. I imagine something really fun or exciting happening in my life.	1	2	3	4
55. When I have a really bad stomach ache, I can get so upset that I can't remember what happened or what I did.	1	2	3	4
56. I try to believe it never happened.	1	2	3	4
57. When I have a stomach ache, sometimes I **can't** control what I do or say.	1	2	3	4

Appendix B

PCS-C

Please rate how strong you experience the following statements when you have pain.

0 = not at all 1 = mildly 2 = moderately 3 = severely 4 = extremely

1. When I have pain, I worry all the time whether the pain will end. _____
2. When I have pain, I feel I can’t go on. _____
3. When I have pain, I feel terrible and think it’s never going to get better. _____
4. When I have pain, I feel awful and it takes over me. _____
5. When I have pain, I can’t stand it anymore. _____
6. When I have pain, I am afraid that the pain will get worse. _____
7. When I have pain, I keep thinking of other painful events. _____
8. When I have pain, I want the pain to go away. _____
9. When I have pain, I can’t keep it out of my mind. _____
10. When I have pain, I keep thinking about how much it hurts. _____
11. When I have pain, I keep thinking about how much I want the pain to stop. _____
12. When I have pain, there is nothing I can do to reduce the pain. _____
13. When I have pain, I wonder whether something serious may happen. _____

Appendix C

Abdominal Pain Index
(Walker & Greene, 1989)

Your Abdominal Pain in the Past 2 Weeks

In the last 2 weeks, how often have you had abdominal pain (stomach aches)?

_____0. not at all
_____1. one or two days
_____2. three or four days
_____3. five or six days
_____4. most days
_____5. every day

Was this pain related to your menstrual period?
___no ____yes ____n/a

In the last 2 weeks, how many times a day did you usually have the pain?

_____0. none
_____1. once a day
_____2. two or three times a day
_____3. four or five times a day
_____4. six or more times during the day
_____5. constant during the day

In the last 2 weeks, when your stomach hurt, how long did the pain last?

_____0. no pain
_____1. a few minutes
_____2. about half an hour
_____3. about an hour
_____4. between one and two hours
_____5. three or four hours
_____6. five or six hours
_____7. most of the day
_____8. all day (it never completely stops)

In the last 2 weeks, when your stomach hurt, how much did it usually hurt?

The MOST pain
Possible
10
9
8
7
6
5
4
3
2
1
0
NO PAIN

What is the most that your stomach hurt in the past two weeks?

The MOST pain
Possible
10
9
8
7
6
5
4
3
2
1
0
NO PAIN

Appendix D

FDI – Parent Form

When people are sick or not feeling well it is sometimes difficult for them to do their regular activities. In the last few days, would your child have had any **physical trouble or difficulty doing these activities?**

1. Walking to the bathroom	No Trouble	A little Trouble	Some Trouble	A lot of Trouble	Impossible
2. Walking up up stairs.	No Trouble	A little Trouble	Some Trouble	A lot of Trouble	Impossible
3. Doing something with a friend. (playing a game)	No Trouble	A little Trouble	Some Trouble	A lot of Trouble	Impossible
4. Doing chores at home.	No Trouble	A little Trouble	Some Trouble	A lot of Trouble	Impossible
5. Eating regular meals	No Trouble	A little Trouble	Some Trouble	A lot of Trouble	Impossible
6. Being up all day without a nap or rest.	No Trouble	A little Trouble	Some Trouble	A lot of Trouble	Impossible
7. Riding the school bus or traveling in a car.	No Trouble	A little Trouble	Some Trouble	A lot of Trouble	Impossible

Remember, you are being asked about difficulty due to physical health.

8. Being at school all day.	No Trouble	A little Trouble	Some Trouble	A lot of Trouble	Impossible Trouble
9. Doing the activities in gym class (or playing sports.	No Trouble	A little Trouble	Some Trouble	A lot of Trouble	Impossible
10. Reading or doing homework.	No Trouble	A little Trouble	Some Trouble	A lot of Trouble	Impossible
11. Watching TV.	No Trouble	A little Trouble	Some Trouble	A lot of Trouble	Impossible
12. Walking the length of a football field.	No Trouble	A little Trouble	Some Trouble	A lot of Trouble	Impossible

13. Running the length of a football field.	No Trouble	A little Trouble	Some Trouble	A lot of Trouble	Impossible
14. Going shopping.	No Trouble	A little Trouble	Some Trouble	A lot of Trouble	Impossible
15. Getting to sleep at night and staying asleep.	No Trouble	A little Trouble	Some Trouble	A lot of Trouble	Impossible

Appendix E

DATE: _____ / _____ /________

MO DAY YEAR

PERSONAL CHARACTERISTICS

1. What is ***your*** birth date? _____ / _____ / _____

   MO DAY YEAR

2. What is the ***patient's*** birth date? _____ / _____ /________

   MO DAY YEAR

3. What is ***your*** age? _________

4. What is the ***patient's*** age? __________

5. What is the ***patient's*** sex? (*Circle one number*)

   Male 1

   Female..2

6. What is ***your*** relationship to the patient? (C*ircle one number*)

   Mother …………………………………………………………………………………1

   Father …………………………………………………………………………………2

   Grandmother ……………………………………………………………………………3

   Grandfather …………………………………………………………………………..4

   Other (*Please write in*) ..……………………………………………………………..5

   ____

7. Which of the following best describes the ***patient's*** racial background?

   (Circle one number)

   American Indian or Alaskan Native 1

   Asian/Oriental or Pacific Islander...2

   Black/African-American..3

Hispanic/Mexican-American..…………………………....4

White/Caucasian/Non-Hispanic...5

Other 6

8. Which of the following best describes ***your*** current marital status?

(C*ircle one number)*

Married...1

Widowed..2

Separated..3

Divorced...4

Never Married...5

9. What is the highest grade ***you*** have completed in school? (*Circle one number*)

8th grade or less 1

Some high school...2

High school graduate 3

Some college or technical/trade school………………………………………………4

College graduate 5

Any post-graduate work...6

If you answered 1, 2, 4, or 6 please give the number of years completed at that level

____

10. What is the highest grade the ***patient*** has completed in school? (*If it is currently a Summer month, please mark the grade most recently completed*)

(*Circle on number*)

2nd grade or less …......……………………………………………………………...1

3rd grade …………………………………………………………………………2

4th grade …………………………………………………………………………3

5th grade …………………………………………………………………………4

6th grade …………………………………………………………………………5

7th grade ……………………..……………………………………………………………..6

8th grade ……………………..……………………………………………………………..7

9th grade ……………………..……………………………………………………………..8

10th grade …………………………………………………………………………………..9

11th grade or higher…………………….. …………………………………………...10

11. **How many people other than the patient lives in the patient's household?**

Number of adults______________

Number of children______________

12. **Which of the following categories best describes the patient's <u>total household income</u> before taxes last year? Please include income from all sources such as salaries and wages, Social Security, retirement income, investments, and other sources.**

Less than $20,000 1

$20,000--$39,999...2

$40,000--$59,999...3

$60,000--$79,999...4

$80,000 or more...5

13. Please list any medications the patient is currently taking:

a) ____

b) ____

c) ____

d) ____

e) ____

f) ____

g) ____

h) ____

i) ____

j) ____

14. Has the patient ever been diagnosed with an anxiety disorder?

    Yes ……………………………………………………………………………………….1

    No ……………………………………………………………………………………...2

15. Has the patient ever been diagnosed with Attention-Deficit/Hyperactivity Disorder?

    Yes ……………………………………………………………………………………….1

    No ……………………………………………………………………………………...2

16. Approximately how many episodes of abdominal pain (pain severe enough to limit activity) has the patient had in the past 12 months?

    ____

17. Approximately when did the patient begin to have episodes of abdominal pain (pain severe enough to limit activity)?

    ____

18. Approximately how many days of school has the patient missed due to abdominal pain within the past 12 months?

    ____

19. Approximately how many doctor visits has the patient made due to abdominal pain within the past 12 months?

    ____

Appendix F

Office for Research

Office of the Chair,
Institutional Review Board for the
Protection of Human Subjects

THE UNIVERSITY OF
ALABAMA
RESEARCH

October 18, 2006

Matthew C. Hocking, M.A.
Psychology
College of Arts & Sciences

Re: IRB # 06-OR-225 "Predictors of Coping in Children with Recurrent Abdominal Pain"

Dear Mr. Hocking:

The University of Alabama Institutional Review Board has granted approval for your proposed research.

Your protocol has been given expedited approval according to 45 CFR part 46. Approval has been given under expedited review category 7 as outlined below:

(7) Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

Should you need to submit any further correspondence regarding this proposal, please include the assigned IRB application number. Please use reproductions of the IRB approved informed consent form to obtain consent from your participants.

Good luck with your research.

Sincerely,

Carpantato T. Myles, MSM
Research Compliance Officer
The University of Alabama

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