TEMPERAMENT, EMOTIONS AND SOMATIC COMPLAINTS IN CHILDREN: CAN APPROACH AND AVOIDANCE TEMPERAMENT HELP EXPLAIN SOMATIC COMPLAINTS IN CHILDREN?

by

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ABSTRACT

Previous research has demonstrated that certain temperamental traits may predispose children to experience somatic complaints in children. The current study tested the ability of an approach-avoidance model of temperament to explain somatic complaints in school-age children. It was predicted that (1) avoidance temperament would be positively associated with somatic complaints, and (2) approach temperament would be negatively associated with somatic complaints. One hundred and seventy seven children, aged 8 - 15 years, completed a computer task and were administered self-reports of behavioral inhibition (avoidance), behavioral activation (approach), emotions, and somatic complaints. Parents reported on their child's approach and avoidance temperament. Results indicate that avoidance temperament significantly explains variability in somatic complaints when child-reports are considered, but this relation is fully mediated by anxiety (for boys only) and negative affect (for girls only). Approach temperament showed no association with somatic complaints.

Keywords: Temperament; Emotion; Somatization symptoms; Children; Behavioural approach; Behavioural inhibition

Subject Terms: Temperament; Avoidance (Psychology); Affect (Psychology); Personality and emotions; Childhood Development

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INTRODUCTION

Everyone experiences aches, pains and physical discomfort at times. Excessive bodily concerns, however, can be a marker for both physical and psychological stress as they are the product of multiple complex pathways between and within organ systems (e.g., brain, gastrointestinal, circulatory, nervous) that are embedded in various environmental circumstances (e.g., family, community, culture). In psychology and psychiatry, much attention has been directed at individuals who present with somatic concerns in the absence of actual physical disease. The idea that individuals may present with somatic manifestations of distress was first addressed by psychodynamic theories of illness (Kirmayer, 1984; Lipowski, 1988). They labelled this type of behavior "somatization" and described it as the experience and expression of distress, conflict and negative emotion through physical means (e.g., headache, sporadic pain, fatigue, etc.)

Psychodynamic theories also posit that somatic mechanisms may compensate for under-developed or maladaptive normative expressions of distress (e.g., behavior, emotional outbursts). Children in particular may be more likely to exhibit this type of expression because of the emotional, linguistic, behavioral and cognitive limitations of development. In other words, development limits the amount and type of skills (e.g., linguistic, cognitive) available to cope with and express distress, conflict and negative emotions. Young children, for example, cannot verbally communicate to their caregivers the quality of their distress nor cognitively process and interpret situations with as much sophistication as adults. Thus, childhood may be a particularly sensitive period for the development and conditioning of somatic mechanisms of expression.

Recurrent physical complaints are quite common in children. Epidemiological evidence suggests that approximately 11% of girls and 4% of

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boys aged 12-16 report frequent and distressing physical complaints (Offord et al., 1987). For some children physical complaints are so recurrent and pervasive that they result in impairment in psychological, social, and academic functioning and a reduction in health-related quality of life. These frequent and pervasive complaints are often not explained by a legitimate organic illness and/or disease. Apley (1975) estimates that up to 10-15% of school-age children experience recurrent abdominal pain (RAP), and that 90% of these children do not have an identifiable gastrointestinal illness or pathology. For these children, somatic complaints are often more indicative of problems with emotional, behavioral, and/or cognitive functioning. In fact, some researchers (e.g., Escobar, Burnam, karno, Forsythe, & Golding, 1987; Garber, Walker and Zeman, 1991) have found that children experiencing four or more somatic symptoms in a period of two weeks have higher levels of internalizing difficulties, primarily anxiety and depression, than children with three or fewer symptoms. In their extensive sample of 540 children, they found that 15.2% had these concurrent internalizing difficulties (Garber et al., 1991).

Research has demonstrated that somatic complaints in childhood have significant developmental continuity (Terre & Ghiselli, 1997). They can be responsible for functional disability as well as considerable medical help-seeking and health-care resource utilization across the lifespan (Barksy, Orav & Bates, 2005; Kaplan, Lipkin, & Gordon, 1988; Ross, Hamilton, & Smith, 1995). This is the case regardless of whether the threshold for a clinical diagnosis of somatization disorder is reached. However, somatization disorder is rarely diagnosed in childhood because of a lack of developmentally appropriate diagnostic criteria and the possibility that somatization in childhood may be quantitatively and qualitatively different than in adulthood.

Although somatizing behavior occurs across the lifespan, very little is known about its etiology and developmental trajectory. What is apparent from research is that somatic complaints develop within a multi-level ecological system, involving individual, inter-and intra-personal, social and cultural influences (Kirmayer & Young, 1998). Despite this, very few putative etiological

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influences have been identified and studied. Most work has focused primarily on parental and family-based influences that affect the learning and socialization processes believed to contribute to illness behaviors in general. These include parental physical illness, illness encouragement, parental or familial preoccupation with illness and health, parental psychopathology, marital distress and specific parenting practices (e.g., low nurturance) (see Campo & Fritsch, 1994 for a review). A few individual-level factors have been studied, including perceptions of stressful life events, heightened bodily perception (see Campo & Fritsch, 1994; Garralda, 1992, 1996 for reviews; Terre & Ghiselli, 1997), psychopathology (e.g., anxiety and depression) (Beidel, Ghrist, & Long, 1991; Garber, Zeman, & Walker, 1990), and temperament (Davidson, Faull, & Nicol, 1986; Garralda, 1992, 1996). These contributors have received less attention in the literature, despite their well-demonstrated role as moderators and mediators of health behaviors and illness outcomes in both adults and children (e.g., Noll, Swiecki, & Garstein, 1994; Walker et al., 2001; Wilson & Evans, 2003). The purpose of the current study is to better understand how temperamental characteristics may make children more vulnerable to experience and report recurrent somatic complaints. In particular, the role of temperamental approach and avoidance sensitivity is examined in relation to reports of somatic complaints in a normatively developing community sample.

Temperament

Temperament is an important factor to consider in the study of somatization, because it represents the foundation from which individual differences in children's behavior, affect, and cognition emerge. Conceptually, temperament is a child's biologically-based predisposition to respond and interact with the environment in predictable, enduring and characteristic patterns (Rothbart & Bates, 1998). Temperament is a multi-level construct in which observable phenotypes represent the interaction of many biological, psychological and social processes. Temperament has many properties that make it a meaningful construct to examine in relation to development in general.

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It is apparent early in life, involves behavioral, affective, biological, cognitive and motivational systems, is highly heritable, demonstrates temporal and cross-situational stability and has a similar structure to the construct of "personality". Empirical evidence has also demonstrated that temperament has considerable developmental continuity, as it is stable in mid-to-late childhood and predictive of personality traits later in life (see Nigg, 2006 and Rothbart & Ahadi, 1994 for reviews).

Research linking temperament to children's cognition, behavior, and health has been hampered by disagreement over how best to conceptualize and measure the construct. Some models emphasize the biological aspects of temperament (i.e., neural-based reactivity, activity level) while others focus more on behavioral and social aspects (i.e., self-regulation, behavioral inhibition, slow-to-warm up). Many classification schemes exist (e.g., Thomas & Chess, 1977; Buss & Plomin, 1986; Caspi, 1998; Rothbart & Bates, 1998; Kagan & colleagues, 1987, 1989), and this has created unnecessary complexity in its definition, measurement and interpretation. Most of these schemes have overlapping dimensions (e.g., emotionality, reactivity, inhibition, surgency) but have been criticized because of their failure to adequately capture the presumed central or underlying mechanisms (Mervielde & Asendorpf, 2000). There are only a few models which attempt to integrate all levels and facets of temperament (e.g., Gray & McNaughton, 2000; Rothbart & Bates, 2006).

Because temperament is stable, biologically-based and purportedly the foundation from which many developmental processes proceed, it may provide a useful starting point for the examination of physical manifestations of conflict and distress. It is well-accepted that temperament sets the basis for responding to environmental contexts, while experience and socialization play a greater role in shaping these responses. In terms of somatic behavior, it is plausible to infer that some children may be temperamentally more prone to respond or behave in ways that, over time and through interaction with other levels of the ecological system, make them more likely to express distress through bodily mechanisms.

Unfortunately, the investigation of the temperamental attributes related to children's somatization has been fraught with unsystematic methodologies and unspecified conceptual frameworks. Several studies, using a variety of classification schemes, have found that frequent somatizers are temperamentally more difficult, anxious, obsessional, and overly sensitive (Davidson et al., 1986; Garralda, 1992). This evidence, however, is largely anecdotal (i.e., based on 20 to 30 year old case studies), terms are not well-defined (e.g., description of a "difficult" child is not operationalized), and the measures used to assess temperament are unstandardized and have questionable psychometric properties (e.g., Newcastle Inventory of Temperamental Characteristics; Garside et al., 1975).

Recent systematic and methodologically-sound studies, however, have reported positive associations between children's somatic symptoms and neuroticism (Meesters, Muris, Ghys, et al., 2003) as well as trait anxiety and anxiety-sensitivity in middle-school aged children (Muris & Meesters, 2004). Although these studies help to illustrate some of the temperament traits that are associated with somatizing in children, they are based on different temperamental classification schemes and theories. Without a unifying theoretical framework of temperament, the understanding and interpretation of the temperamental attributes related to somatic behavior will continue to be inconsistent. Past literature also does not provide a comprehensive and multi-level understanding of the relationship between temperament and somatic complaints. In particular, it would be important to have a framework that explains behaviour across multiple levels or domains (neural, cognitive, behavioural, affective), as this will provide richer information about the complexities of the phenomenon.

The current study addressed these limitations by investigating the temperamental underpinnings of somatizing behavior in children using a simplified model of temperament that is theoretically meaningful and can be measured with psychometrically acceptable assessment instruments across various domains and reporters. The model used in this investigation is Gray's

Reinforcement Sensitivity Theory (RST), which posits that temperament can be represented as individual differences in levels of behavioral activation (i.e., approach) and behavioral inhibition (i.e., avoidance). As will be discussed below, these neurally-based propensities to respond to environmental stimuli are believed to be the primary structural components of temperament and personality. As such, this model has the potential to better illuminate some of the individual-level factors that are involved in somatizing behavior.

The Structure of Temperament

The attractiveness of Gray's theory is that it provides a simplified way of conceptualizing temperament. Historically, temperament has been described and conceptualized in many ways (e.g., "slow-to-warm-up", "easy", "difficult", "activity level", "persistence", "effortful control", "surgency"). Very little work has been conducted that analyzes what all of these attributes have in common or can be reduced to in functional terms. In the early 1990s, item-level factor analytic studies uncovered a five dimensional model of the central or core constructs of temperament (e.g., fearfulness, irritability/anger/frustration, approach or positive affect, activity level, and attentional persistence; Rothbart & Mauro, 1990), but a few years later scale-level factor analytic studies produced a somewhat different model consisting of three dimensions (e.g., surgency/extraversion, negative affectivity, and effortful control; Rothbart et al., 1993). The poor overlap of these putative *core* temperamental traits along with their limited theoretical basis fueled investigation of other models with fewer underlying dimensions and more explanatory power (i.e., explains behavior across many domains of functioning, see Nigg, 2006).

Authors of these new simplified models hypothesize that temperament, and the behaviors and emotions that characterize it, are the products of underlying neurobiologically-based systems or mechanisms. One of the most accepted of these models is one that describes children's biologically-based predispositions to interpret, interact and respond to the environment in terms of approach and avoidance sensitivity. The notion of approach and avoidance

sensitivity is not new (James, 1890), but has recently received considerable attention and empirical support as a meaningful way to conceptualize temperament (Elliot & Thrash, 2002; Putnam & Stifter, 2005). In a recent article, Elliot and Thrash (2002) argue that the distinction between approach and avoidance sensitivity is fundamental to understanding temperament because it appears to capture the *core* constructs of temperament/personality. In their factor analytic studies they demonstrated that many personality and temperamental constructs (e.g., positive and negative affect, introversion, extraversion, anxiety, impulsivity) all have in common two basic underlying neurobiological systems that are sensitive to perceived positive and negative stimuli and produce particular affects and behavior. These systems are believed to be the approach and avoidance systems. The approach system subsumes extraversion, behavioral activiation and positive affect; the avoidance system neuroticism, negative affect and behavioral inhibition. Others also argue that approach and avoidance/withdrawal are the basic dimensions of the hierarchical structure of temperament/personality (e.g., Beauchaine, 2001; Calkins & Fox, 2002; Nigg, 2006). Support for this hierarchical model can be found not only in studies of personality structure, but also from cognitive neuroscience studies which have identified physiological indices (e.g., neural structures, CNS & PNS markers) of approach and avoidance (Beauchaine, 2001; Calkins & Fox, 2002; Shiner & Caspi, 2003; Tackett & Krueger, 2005).

Gray's Reinforcement Sensitivity Theory

The most comprehensive, well-accepted and empirically-validated approach-avoidance model is Gray's Reinforcement Sensitivity Theory (1972, 1982, 1991, 2000) which posits that two neurologically-based systems are responsible for and control approach and avoidance behaviors – the *behavioral inhibition system* (*BIS*) and *the behavioral activation system* (*BAS*). Rooted in behavioral neuropsychology, Gray's theory has been labeled as both a model of temperament/personality and passive motivation (i.e., automatic response). Gray proposes that these two systems modulate responses to aversive and appetitive

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stimuli in the environment which result in different behaviors and emotions. According to Gray's model, the neurobiological basis of the BIS includes the septohippocampal system and its neocortical projections from the entorhinal and prefrontal cortex, and the 'Papez Circuit'. It is sensitive to aversive stimuli such as cues of punishment, nonreward, and novelty and triggers avoidance behavior through physiological arousal. BIS stimulation interrupts ongoing behavior, increases arousal and directs attention toward the aversive stimuli. This neural-based arousal leads to anxiety which further interrupts behavior and initiates negative emotions (e.g., sadness, fear). Less is known about the neurobiological basis of BAS, but evidence is suggestive of a dopaminergic role. It is sensitive to appetitive stimuli such as cues of reward and non-punishment and triggers approach behaviors and goal-directed activity when activated. As such, BAS initiates pleasurable and positive emotion states (e.g., elation, happiness, excitement).

Gray's theory has received substantial empirical attention and support in regards to the study of personality because of its ability to describe behavior in terms of two very fundamental responses (approach vs. avoidance), as well as account for emotion states (Matthews & Gilliland, 1999) that are strongly associated with specific temperament and personality traits. Although Gray initially tested his model through animal-based research (e.g., involving pharmacological and brain-lesion manipulations), many new studies have been published extending the theory to human populations. In particular, many survey and laboratory based assessment instruments have been developed and these have validated much of the earlier animal research. The most widely used survey instrument is the BIS/BAS Scales (Carver & White, 1994), and newer instruments are continually being developed and refined (e.g., Sensitivity to Punishment and Sensitivity to Reward Questionniare (SPSRQ); Torrubia, Avila, Molto & Cesaras, 2001).

Studies utilizing the BIS/BAS scales (Carver & White, 1994) have found that BAS is associated with trait measures of extraversion, positive affect, and impulsivity. BIS, on the other hand, is related to high self-reported levels of

neuroticism, anxiety, depression and negative affect (Gable, Reis & Elliot, 2000; Jorm et al, 1999; Johnson, Turner & Iwata, 2003). Other laboratory-based assessment instruments have been developed and/or used (e.g., PSRT reaction time task involving reward and punishment stimuli; CARROT card sorting task involving incentive; psychophysiological indeces of approach and avoidance – EEG asymmetry, SCL response, cortisol concentrations) and their application to the study of BIS and BAS is promising. These alternative measures have the potential to add incremental validity to survey instruments as well as provide a multi-modal, more reliable, and perhaps more "pure" assessment of BIS (or avoidance) and BAS (or approach). PNS, CNS, and behavioral measures of temperament may eliminate the measurement error associated with differences in individual perception (i.e., self-reports) and language.

Most of the aforementioned assessment instruments have been developed and validated with adult populations. Recent investigations have examined their utility with school-age children and the results are consistent with the adult literature. For example, two studies have examined the factor structure and applicability of the BIS/BAS Scales (Carver & White, 1994), one using the exact adult version and one using a revised downward version. Both studies reported similar correlations with the suggested personality traits/ behavioral components (e.g., extraversion, introversion) and emotion states (e.g., anxiety, positive and negative emotion) (Coplan, Wilson, Frohlick & Zelenski, 2006; Muris, Meesters, de Kanter, & Timmerman, 2005). The use of psychophysiological measures of approach and avoidance has produced mixed results. Reaction time tasks appear to be more reliable measures compared to skin conductance and cortisol assays, but more research is needed to make firm conclusions. In particular, the Point Scoring Reaction Time Task (PSRT) in which punishment and reward is manipulated in response to correct or incorrect answers to math questions, appears to be a valid index of BIS and BAS. Colder and O'Connor (2004) found that parent-reported levels of sensitivity to punishment and sensitivity to reward predicted children's responses to reward and punishment-

type trials during the task. However, these findings are preliminary and need to be replicated.

In his original model, Gray (1982, 1991) argued that BIS and BAS were orthogonal systems – the separable subsystems hypothesis. In particular, he argued that BIS and BAS are functionally independent because they involve different circuitry, are activated by different stimuli, and are responsible for different emotions and behavior. A recent reformulation of the model (Gray & McNaughton, 2000) outlined that BIS and BAS operate independently only when appetitive and/or aversive stimuli are strong (i.e., are perceived as a serious punishment or reward such as potential for death) and are not presented together (i.e., the stimuli does not represent an approach-avoidance conflict). Because these situations are rarely encountered in everyday life or in laboratory situations, Corr (2002) has argued that this reformulation of the model makes it difficult for BIS and BAS to act independently. In response, Corr has proposed an alternate model of BIS and BAS functioning, one that takes into account the joint effort of BIS and BAS – the *joint subsystems hypothesis*. In particular, his research demonstrates that it is imperative to study human affect and behavior as a reflection of *joint subsystems*, such that levels of BIS and BAS sensitivities combine to produce individual differences in behavior, affect and cognition. Corr's assertion is an important one because it captures the complexity of the interplay between brain systems, behavior, cognition and affect and extends Gray's theory to represent this complexity.

Corr (2002) argues that individuals with a strong BIS and weak BAS will be the most sensitive to punishment. He believes this to be the case because BIS and BAS operate under predominantly antagonistic action (anxiety inhibits approach behavior and positive affect inhibits avoidance behavior). It would then be expected that individuals with a strong BIS and weak BAS would experience the most negative outcomes in terms of anxiety, negative affect and maladaptive behavior because a strong BIS, in a way, dominates the negative feedback loop. In fact, new person-oriented evidence (i.e., examining different combinations of variables within individuals rather than individual variables across individuals)

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suggests that children with this high BIS-low BAS sensitivity (termed as *avoidant* children) do experience the most negative psychosocial and emotional outcomes (Coplan, Wilson, Frohlick & Zelenski, 2006; Corr, 2001; Windle, 1994).

While Corr does not speculate about the outcome of a strong BAS -strong BIS combination, it could be inferred that because both systems are highly sensitive and both acting antagonistically, the net effect would be a strong propensity to avoid along with an equally strong propensity to approach. It has been found that adults with this approach-avoidance combination demonstrate the most aversive responses to stimuli (Kambouropoulos and Staiger, 2004) and the most severe psychopathological outcomes – a combination of serious internalizing and externalizing problems (Windle, 1994). In children, Blair, Peters and Granger (2004) found that this particular group of children demonstrated the highest levels of physiological markers of stress; namely, high initial cortisol levels during an executive functioning task and low resting vagal tone. This research suggests that these children appear to have a specific physiological profile characterized by impaired physiological flexibility that is related to reduced ability to self-regulate and poor executive functioning. Corr's *joint subsystems hypothesis* has not been examined in relation to physical illness, or presence of physical complaints. The current study tests Corr's hypothesis by examining if and how different levels of avoidance (or BIS) and approach (or BAS) are related to somatic complaints in children.

Approach-Avoidance Temperament and Somatic Complaints

Gray's *Reinforcement Sensitivity Theory* is a unique framework from which to study somatization in children because the effects of a highly sensitive BIS, in particular, (e.g., negative affect, anxiety, depression, neuroticism) are also highly associated with frequent somatic complaints in children (Garber et al., 1990; Garralda, 1992, Beidel et al., 1991). Using a temperament framework, negative emotion states may be partially caused by a broad temperamental predisposition to feel and experience negative emotions more often and more intensely. This then disrupts other biological and psychosomatic pathways that

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can lead to frequent somatic complaints. The potential temporal sequence of the relation between these three constructs might be avoidance temperament leading to negative emotions and anxiety which then leads to somatic complaints. This conceptualization places temperament, BIS especially, as the underlying latent structure or mechanism that accounts for the relationship between anxiety, depression and somatic complaints. In this study, I do not examine this temporal sequence, however, I do try to demonstrate that avoidance temperament, as it is currently measured, is positively related to somatic complaints and is a useful construct from which to examine somatic behavior in children.

Several processes may underlie the association between avoidance and somatic complaints. With respect to avoidance, the physiological and affective products of a neural-based avoidance sensitivity, such as physiological arousal, increased attention toward aversive cues, and a strong tendency to feel negative emotions, may be primary. Because temperament is stable, these effects may become more chronic and lead to other processes which may increase vulnerability to somatize. These processes might be (1) avoidance of psychological distress, and (2) chronic arousal. First, active avoidance of emotion evoking situations or of emotional conflict does not effectively resolve the psychological conflict; it instead seeks to reduce the associated emotional distress (Gentry & Kobasa, 1984). This may result in the disruption of other pathways that lead to psychosomatic expression. For example, there is a large literature supporting the notion that many types of avoidance (e.g., cognitive avoidance, inhibition of emotional expression, and lack of self-disclosure) are associated with negative health outcomes (Petrie et al., 1995; Rachmann, 1980, Friedman, Tucker, Tomlinson et al., 1993; Soderstrom, Dolbier, Leiferman & Steinhardt, 2000; Suls & Fletcher, 1985; Toukmanian & Brouwers, 1998). For example, in a sample of children Penza-Clyve and Zeman (2002) found that reluctance to communicate emotions was found to be positively related to frequency of somatic complaints.

Alternatively, or additionally, the high level of arousal associated with BIS activity may lead to poor regulation of emotion which may disturb other biological subsystems and result in physical symptoms. Taylor (1999) labelled this as the 'Dysregulation Hypothesis'. There is also much literature to support the argument that both acute and chronic stress and arousal can lead to physical illness. For example, chronic central nervous system arousal can cause changes in the gastroenterological system which can lead to degeneration of internal organs and uncharacteristic functioning of the auto immune system (e.g., Compas & Thomsen, 1999; Chrousos et al., 1995). The lack of longitudinal studies in this area makes cause-and-effect relationships between physical illness and arousal difficult to specify. Therefore, it is also possible that negative emotions, rather than the arousal itself, alter physiological activity (Kellner 1991; 1994). However, it is difficult to separate the two as they are mutually dependent. Thus, temperamental avoidance may be related to both somatic illness and real illness. This study, however, is more concerned with the possible relation between avoidance temperament and somatic illness and the mechanisms via which this may occur.

Approach behaviour may also play a role in somatic complaints. In particular, because BAS involves orienting behaviour toward a stimulus (i.e., behavioural facilitation) and is responsible for positive feelings that inhibit avoidance it may be negatively related to somatic complaints. Approach behaviour and positive affect are both related to positive emotional functioning (e.g., Coplan et al., 2006; Muris et al., 2005; Shiner & Caspi, 2003) and overall health (e.g., Tsaousis, Nikolaou, Serdaris, & Judge, 2007). Approach behavior may enable individuals to effectively deal with emotional conflict and thereby prevent somatization. In other words, the experience of positive emotions may be helpful in explaining why children *do not* experience somatic complaints. Also, it is plausible that because approach temperament underlies the experience of positive affect, positive affect might be a stronger predictor of somatic complaints because it more proximally related to somatic complaints.

There may be a limit to the benefits of approach behaviour, however. Exaggerated approach behavior is associated with impulsivity and in fact many empirical investigations have focused on this as an explanation of externalizing psychopathology in children (e.g., ADHD, Conduct Disorder; Quay 1993) and addiction-related problems in adults (Johnson, Turner, & Iwata, 2003). Considerable attentional difficulty, distress and conflict is associated with impulsivity, therefore, it would be expected that children with strong approach sensitivities may not experience physical discomfort because their attentional resources are devoted elsewhere. Given this, it is expected that BAS sensitivity will be negatively associated with physical complaints in children. However, this relation may not be linear as the upper limits of BAS sensitivity are reached. In particular, low and mid-range values of BAS may not be associated with emotional problems but high levels of approach would. Many studies have documented the negative effects of very sensitive approach tendencies (see Fishbein, 2000; Kane, Loxton, Stager & Dawe, 2004; Leutner & Rammsayer, 1996), but very few have tested possible non-linear relationships.

In summary, Gray's model allows multi-dimensional measurement and analysis (e.g., neural, behavioral, affective) that reflects our current understanding of the structure of temperament and its interaction with physical and other psychological processes. Gray's model may be able to provide a richer understanding of the mechanisms and processes involved in somatization, compared with other models that often look at domains of functioning in isolation from one another or focus more on emotions and/or personality traits (Cloninger, 1986, 1988, 1991; Eysenck 1967; Eysenck & Eysenck, 1985; Tellegen, 1985) as predictors of functioning. These models do a good job of explaining the products of temperamental systems but do a poor job of delineating or providing insight into the latent structures, mechanisms and/or the biological underpinnings of these products (Larsen & Ketelaar, 1989, 1991).

The Current Study

The purpose of this study was to examine the relationship between approach and avoidance temperament (BIS-BAS sensitivity) and somatic complaints in school-age children using a cross-sectional design. Approach and avoidance temperament is assessed on multiple levels and across multiple reporters. Specifically, behavioural and survey instruments are used as are both parent and child perspectives. This type of design enabled a more reliable measurement and analysis across multiple domains of BIS/BAS assessment and reporting. Concurrent measures of emotions (i.e., anxiety, depressive symptoms, negative and positive emotion) are also included to better understand the nature of the relationship between approach-avoidance temperament, emotions and somatic complaints. Models that examine both the independent and interactive effects of BIS and BAS are tested. It is hoped that this study will lay the groundwork for further investigation into the processes by which avoidance (BIS) and approach (BAS) may influence physical functioning in children.

Hypotheses

(1) Avoidance Temperament. The primary hypothesis for the current study was that avoidance temperament will be positively associated with somatic complaints. However, because internalizing difficulties are purportedly more proximally related to somatic complaints, it is expected that internalizing problems will mediate the association between avoidance temperament and somatic complaints. In particular, (a) avoidance temperament will be positively related to internalizing problems (negative affect, anxiety, depressive symptoms), (b) avoidance temperament and internalizing problems will be independently and positively associated with somatic complaints, and (c) after controlling for internalizing problems, avoidance will no longer be significantly associated with somatic complaints.

(2) Approach Temperament. It is also hypothesized that approach temperament will be negatively associated with somatic complaints. However,

because positive emotions may be more proximally related to somatic complaints, positive emotions will mediate the association between approach temperament and somatic complaints. Specifically, (a) approach temperament will be positively related to positive emotions, (b) on their own, approach temperament and positive emotions will be negatively related to somatic complaints, and (c) after controlling for positive emotions, approach will not be significantly related to somatic complaints. In addition, it was hypothesized that approach temperament would be non-linearly related to internalizing problems (depressive symptoms, anxiety, negative affect). This has been argued conceptually be never tested empirically.

(3) Approach-Avoidance Temperament. As secondary to the above hypotheses and consistent with previous research suggesting that BIS and BAS jointly operate, it was predicted that different combinations of avoidance and approach temperament would show differential relations with somatic complaints. In particular, children who are both highly avoidant and low in approach will have higher somatic complaints scores than children with other combinations of BIS and BAS.

Finally, it is expected that the relations hypothesized above will be found across reporters and measures. As well, it was predicted that avoidance temperament would be a stronger predictor of somatic complaints than approach temperament, since it is partially responsible for the negative emotions and anxiety that tend accompany somatic complaints.

METHODS

Participants

One-hundred and seventy-seven children (female n = 90; male n = 87), aged 7.8 to 15.33 years (M_{age} = 11.17, SD = 1.84) participated in the current study. They were recruited from a university-based summer camp and through local newspapers in a large, metropolitan area. Children with chronic health conditions (e.g., thyroid disease, cancer, diabetes) and/or were currently suffering or recovering from a cold/flu were excluded from the analysis to ensure that the rate of physical complaints was not erroneously inflated due to these illnesses. One child was excluded from analyses for this reason.

Eighty-five parents also participated in the study, 78% of whom were mothers. Demographic information was available only for 115 children because some parents did not consent to participate or did not want to provide this information. Participating children tended to come from households with a high level of education; 13% of mothers had only a high-school education 24% had a college or technical degree, 45% had a university degree and 18% held a graduate degree. Maternal education was used as a proxy for socioeconomic status because (1) paternal education levels were similar to maternal education and (2) a majority of reporters were mothers. The cultural background of most children was Asian (including Chinese, Japanese, Korean, Taiwanese, and Pilipino). In terms of parent birthplace, 64% of mothers were born in Asia, 24% in Canada and 12% in other areas (e.g., South America). The breakdown of child birthplace was quite different, with 36% of children being Asian-born, 60% Canadian-born and 4% other-born. Although immigration information was not collected, this data indicates that a majority of participating children may have come from immigrant families and were first-generation Canadians. Parental-birth place was used as an indicator of cultural background in the current study because it better reflects the dominant cultural background of 1st generation

immigrants. Western acculturation tends to be greater among 2nd generation immigrants. In terms of familial structure, 87% of children lived in two-parent families and 13% were from separated or divorced families.

Procedure

This study consisted of three experimental components. First, children completed a computer-based reaction time task (Point Scoring Reaction Time Task; Colder & O'Connor, 2004). Next, the children filled out a set of questionnaires examining somatic complaints, behavioral inhibition and activation, positive and negative emotions, anxiety, and depressive symptoms. The third component involved parents providing ratings of their child's temperament via two questionnaires. Data for every experimental component was not obtained for every child due to equipment malfunction and other uncontrollable factors (e.g., parents consenting to have their child participate but declining to participate themselves). Sample size, therefore, varies throughout the analyses. Seventy-three sets of full data were obtained. Child-only measures (i.e., computer task and surveys) were obtained for 146 participants. When only child-report surveys were examined, sample size ranges from 154 to 177.

A few parents had difficulties with the English language. Accommodations were made to enable these non-English speaking parents to participate. Nine parents completed translated versions of the temperament surveys (Mandarin n = 3, Cantonese n = 1, Korean n = 5). These three translations were completed in a manner consistent with accepted standards (Brislin, 1970). First, the two questionnaires were translated by bilingual translators into Cantonese, Mandarin and Korean. These translations were then back-translated into English and discrepancies were identified. Items in which meaning was not retained by the translation were modified as best they could. Finally, an independent native speaker familiar with child behavior looked over the items to verify its comprehension and cultural appropriateness.

The data were collected via one of two methods – group administration or individual family laboratory visits. Children participating as part of their university-

based summer camp completed the study protocol in groups of 5 to 10 in a university computer laboratory in the summer of 2006 (n = 94) and 2007 (n = 69). Parents of these children were interviewed individually over the phone to obtain ratings of their children's temperament. The other study participants, including parents, completed the protocol individually in a child development research laboratory at Simon Fraser University (n = 14).

Measures and Stimuli

Somatic Complaints

Frequency and intensity of children's somatic complaints were assessed using the *Children's Somatization Inventory – short form (CSI-18;* Garber et al., 1991) (see Appendix A). The CSI-18 consists of 18-items relating to four types of somatic symptoms (cardiovascular, gastrointestinal, weakness/pain, conversion). Children are asked to indicate how many times they have experienced these symptoms in the last 2 weeks. Answers range from 0 (not at all) to 4 (a whole lot). The CSI is a widely-used and well-supported instrument. It has demonstrated good test-retest reliability in clinical samples (r =.62; Walker et al., 1991) and acceptable internal consistency (α = 0.85 to 0.92; Garber, Walker & Zeman, 1991, Walker & Garber, 2003). It has good concurrent validity, as it correlates with similar scales measuring somatic complaints (Achenbach, 1978; Achenbach & Edelbrock, 1979; Pennebaker, 1982). It correlates with internalizing difficulties (e.g., anxiety, depression, perceived competence), thus demonstrating good construct validity (Walker et al., 1991 and Garber et al., 1991). This survey is a measure of the frequency and intensity of somatic complaints in children and adolescents. It is not a diagnostic instrument nor was it used this way in the current study.

Internalizing Measures

Depressive Symptoms. Children also completed a measure of depression, the Child Depression Inventory – short form (CDI; Kovacs, 1992) (see Appendix B). The CDI is a 37-item self-report questionnaire used to assess the feelings, emotions and behaviors associated with depression in children and adolescents, aged 7-17 years. The short form is an abbreviated version of the full CDI, used as a quick measure of depressive symptoms in children. It was developed by using backward stepwise internal consistency reliability with the original normative sample. Children are asked to choose a sentence (out of three given for each item) for each item that describes the way they have been feeling and behaving recently. For example, for one question, a child is asked to pick from the following three sentences: (1) "I am sad once in a while", (2) "I am sad many times", and (3) "I am sad all the time". Each item is scored on a 3 point scale from 0 to 2. The CDI-S correlates (r =.89) with the CDI full form and its alpha reliability coefficient is .80. It has demonstrated poor discriminant validity in a sample of 134 children diagnosed with different forms and combination of depression (Kovacs, 1992). However, the authors warn that the CDI and CDI-S should not be used as diagnostic tools. In the current study, the CDI-S was used to assess the presence of depressive symptomatology.

Anxiety. Children's anxiety symptomatology was measured using the *Multidimensional Anxiety Scale for Children – 10 (MASC-10;* March, 1997) (see Appendix C). The MASC-10 is a short form of the MASC, which contains 39 items designed to identify anxiety symptoms in children 8-18 years of age in four areas: physical symptoms, harm avoidance, social anxiety, and separation/panic. The MASC-10 consists of ten MASC items and was created as a short assessment of general anxiety. In creating the MASC-10, March (1997) selected items based on their loadings of a one-factor solution of the MASC. There are 10 items answered scored on a 4-point likert scale (*0 = never true about me, 4 = often true about me*). An example of one of the ten items is, "The idea of going away to camp scares me." In the normative sample, the correlation between the MASC-10 and MASC total anxiety score was high (r = .90) for both males and

females. The internal reliability, three month test-retest and convergent validity of the MASC-10 was acceptable. Discriminant ability was also good ($r =.24$ to .40 with depression) (March, 1997).

Positive and Negative Affect. Children's emotional state was assessed using the Positive Affect and Negative Affect Schedule for Children (*PANAS-C*; Laurent at al., 1999) (see Appendix D). This self-report measure evaluates positive and negative emotions in children aged 9 – 13 years. There are fifteen items on both the positive affect (PA) and negative affect (NA) scale. The items consist of one-word descriptors of possible emotions and feelings and children are asked to rate, on a scale of 1 (*very slightly*) to 5 (*extremely*), how well each adjective describes how they are currently feeling or have been feeling recently. Examples of the items for the positive affect subscale are "interested", "excited" and "happy" and examples of the negative affect subscale are "upset", "guilty", and "sad". The PANAS-C has demonstrated good psychometric properties. Both subscales displayed good internal consistency in the normative sample, with an alpha-coefficient of .92 for the NA scale and .89 for the PA scale. When assessed with self-report measures of anxiety and depression, the PANAS-C also shows good convergent and discriminant validity (Laurent et al., 1999).

Temperament Measures

Approach-Avoidance Temperament. To assess behavioral inhibition and behavioral activation sensitivity children completed the *BIS/BAS Scales child self-report* (Coplan et al., 2006; Muris et al., 2005) (see Appendix E). The *BIS/BAS Scales child self-report* consists of 20 items divided into the BAS (i.e., drive, reward, fun) and BIS scale (i.e., punishment). The two-factor structure has been shown to be more reliable than the four scales (Coplan et al., 2006). The two-factor structure was used in the current study for this reason. Example items from the BAS and BIS scales respectively are: *"I'm always willing to try something new if I think it will be fun"* and *"I worry about making mistakes."* Each item is scored on a four-point likert scale, from 0 (indicating an item is *"not true of me"*) to 4 (indicating an item is *"very true of me"*). This measure is a modified

version of the adult self-report created by Carver and White (2004). The BIS scale correlates with self-reported depressive symptoms, anxiety, and low self-worth, emotional problems, neuroticism and lower levels of extraversion. BAS is related to lower levels of depressive symptomatology, negative affect and anxiety and higher levels of extraversion, hyperactivity and aggression (Coplan et al., 2006; Muris et al., 2005). Research has also found that the factor structure is very similar to the adult-report and that the internal consistency reliability is adequate for the BIS items and good for the BAS items (Frohlick & Coplan, undergraduate thesis, 2004, a portion of which was published in Coplan et al., 2006).

The *BIS/BAS Scales parent-report version* (e.g., Blair, 2003) (see Appendix F) was administered to parents. All 20 items are the same as the child self-report but have been reworded to reflect the change in rater. Parents are asked to respond on a scale of 1(*extremely untrue of my child*) to 7 (*extremely true of the child*). Blair et al. found that scores on the BIS scale were related to adaptive behaviour as reported by teachers and explained variance in social competence and on-task behaviour in the classroom. Using this measure in a subsequent investigation, Blair et al. (2004) found that parent-reported BIS was positively correlated with physiological indicators of stress reponses and reduced cognitive self-regulation. The opposite was found for BAS.

Parents were also asked to complete the *Sensitivity to Punishment and Sensitivity to Reward Questionnaire (*SPSRQ; Torrubia et al., 2001) (see Appendix G). This scale is an another measure of BIS and BAS, but is believed to better reflect Gray's Reinforcement Sensitivity Theory because it directly assesses sensitivity to reward and punishment rather than domains related to, but not indicative of, sensitivity (e.g., social anxiety) (Colder & O'Connor, 2004). The initial SPSRQ has 38 items divided in two scales – sensitivity to reward and sensitivity to punishment. The SPSRQ-parent report (Colder & O'Connor, 2004) has been reduced to 33 reworded items with 4-factors similar to the BIS/BAS Scales – sensitivity to punishment, impulsivity/fun seeking, drive and reward responsivity. The questionnaire has had limited use, but has demonstrated good

internal consistency (α = .69 to .87) as well as convergent and discriminant validity with behavioral and parent-report measures of internalizing and externalizing behavior (Colder & O'Connor, 2004).

Point Scoring Reaction Time Task. The point scoring reaction time task (PSRT) is a computerized behavioural measure of sensitivity to reward and punishment. It was created by Avila (2001) and modified by Colder and O'Connor (2004) to be more appropriate for children. The PSRT was used as a behavioural test of approach and avoidance sensitivity to compliment the self or parent report measures. The PSRT was programmed using E-Prime Version 1.0. Children responded to stimuli via colour-coded arrow keys on a computer keyboard. The task had four components: 20 practice trials and three blocks of 100 3-second trials. The three blocks, pre-punishment, punishment and post-punishment, were presented in the same order to every child. The stimuli consisted of a coloured circle directly above a two-digit number. This presentation was the same across the blocks. Children were asked to identify the two-digit number as even or odd using the appropriate arrow key on the keyboard. Correct responses were rewarded by earning points dependent on reaction time (points = 635/reaction time in ms.). Incorrect responses were punished with a loss of 3 points. The number of earned points was displayed in the bottom left-hand corner of the screen so that children could monitor their progress during the task.

As noted above, the PSRT consisted of three blocks of trials. In the first block (referred to as the pre-punishment block), children were told to ignore the coloured circles and just respond to the two-digit number. This was followed by a second (punishment) block in which children were told that responding to trials in which a red circle was present would result in a loss of 50% of their points, even if the response was correct. The red circles in this block therefore acted as punishment cues. Eight of the 100 trials were punishment trials (i.e., included a red circle). In the final block (the post-punishment block), children were told to respond as usual (i.e., ignore the coloured circles and respond to the two-digit number) and that responding to trials with a red circle would no longer result in a loss of 50% of points. There were eight red circle and 92 non-red circle trials in

each block. This task was presented to children as an attractive game-like scenario. They were told that the object of the game was to get as many points as possible.

Children were screened for ability to discriminate odd and even numbers prior to beginning the task. Children who demonstrated difficulty with this task were given further instruction. If problems were still apparent, children were given an alternate activity to complete. Two children displayed difficulties understanding the odd-even distinction and their data were not included in the final data set.

For the PSRT, reaction times are the outcome variable. Mean reaction time in milliseconds (ms) was calculated for pre-punishment block reward trials (all red and non-red circle trials), punishment block reward trials (non-red trials), post-punishment reward trials (non-red circle trials) and post-punishment punishment trials (red circle trials). Within the punishment block, non-red circle trials were counted as reward trials because children were rewarded for correct responses. It was expected that RTs would increase from the pre-punishment reward trials to the punishment reward trials. That is, the introduction of a punishing stimuli would cause children to respond slower to the punishment block to reward trials compared to the pre-punishment reward trials in which there were no punishment cues. For children who are more temperamentally sensitive to reward (i.e., approach behavior or behavioral activation (BAS), it was expected that they would show less slowing. In other words, children who are behaviorally activated are more sensitive to reward and therefore will not show as strong a response to punishing stimuli. Their mean difference in RTs from the pre-punishment and punishment blocks will be smaller. In the post-punishment block, slower responses to red circle trials compared to non-red circle trials are expected because these circles were signals of punishment in the previous block. Thus, carry-over effects are expected. As such, all participants' mean RTs for non-red circle trials in the post-punishment block are expected to be lower than for red circle trials. However, children who are more temperamentally avoidant and behaviorally inhibited (high BIS) are expected to be more sensitive

to punishment and thus will show a greater difference in mean RTs across these two indices. That is, RTs will increase from non-red circle trials to red circle trials, but there will be more slowing for children who are more avoidant or sensitive to punishment.

The PSRT was originally tested and validated with an adult population (Avila, 2001). Colder and O'Connor modified the task (increased the trial duration and decreased the number of points lost) for children. Both studies found that sensitivity to punishment and sensitivity to reward both predicted the expected differences in RTs across all participants. In addition, Colder and O'Connor found that children with a high sensitivity to punishment showed greater, but not statistically significant, slowing of reaction times from the non-red post-punishment trials to the red post-punishment trials than did children with a low sensitivity to punishment. A significant effect of BAS impulsivity/fun seeking was also detected. Children who were more impulsive showed less slowing of reaction times between the pre-punishment and punishment block reward trials.

Other Measures

Child Health Screen. An assumption of the current research was that participating children were in good health and were reporting normative somatic complaints. Therefore, parents were asked a short series of questions regarding their child's current and past health problems (see Appendix H). This was used a screen for current short-term and/or chronic illnesses that could influence the number and type of somatic complaints that children reported.

Table 1 summarizes the information obtained from parents and children.

Table 1:   Internalizing problems and temperament indices used in the current study

Study Variables

Internalizing Indices – child self-report
    Somatic Symptoms (CSI-18)
    Anxiety (MASC-10)
    Depressive Symptoms (CDI-S)
    Positive Affect (PANAS-C)
    Negative Affect (PANAS-C)

Temperament Indices
    Avoidance
        Child-reported Behavioral Inhibition Sensitivity (BIS)
        Parent-reported Behavioral Inhibition Sensitivity (BIS)
        Parent-reported Sensitivity to Punishment (SP)
    Approach
        Child-reported Behavioral Activation Sensitivity (BAS)
        Parent-reported Behavioral Activation Sensitivity (BAS)
        Parent-reported Sensitivity to Reward (SR)

Computer task derived scores (Point Scoring Reaction Time Task)
    Sensitivity to Reward (SR)
    (RTs in pre-punishment vs. punishment block)

    Sensitivity to Punishment (SP)
    (RTs in non-red circle trials vs. red circle trials in post-punishment block)

RESULTS

Preliminary Analyses

Demographic Analyses.

The effect of demographic (i.e., age, gender, parental birthplace, maternal education) and experimental (i.e., session type) characteristics on children's emotional functioning and temperament is presented below.

Pearson product moment correlations indicated that age was negatively correlated with child-reported BAS (r = -.176, p = .020). Group differences due to gender were also examined in relation to all internalizing and temperament variables. A MANOVA was run to examine possible gender differences in negative emotional functioning (i.e., anxiety, negative affect, depressive symptoms, somatic complaints). A main effect for Gender was not detected (*Pillai's V* = .032, $F(4, 165)$ = 1.36, p =.251). Gender differences in positive emotion were investigated with t-tests. Female and male children did not differ in their ratings of positive affect, $t(170)$ = -.017, p = .986. With respect to child-reported temperament, females rated themselves higher on BIS ($t(174)$ = -3.16, p = .002) but not BAS ($t(174)$ = -.548, p = .585). There were no gender differences on parent-reported temperament indices.

Possible differences in internalizing and temperament due to parental birthplace were also investigated using MANOVA and ANOVA. Two groups based on parental birthplace were created: Asian/Other and North American/European. A significant multivariate effect for Parental Birthplace was not found with respect to internalizing problems (*Pillai's V* = .063, $F(4, 106)$ = 1.79, p =.136). There was however a difference in children's self-reported positive affect. Children born to North American/European mothers rated themselves higher than children born to Asian/Other mothers on positive affect

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(t(111) = -2.68, p = .008). T-tests indicated a significant difference due to parental birthplace in relation to parent-reported sensitivity to punishment only (t(78) = 2.82 , p = .006). For this temperamental index, Asian/Other born parents rated their children higher on sensitivity to punishment than North American/European born parents. There were no differences in child-reported temperament.

There was a significant multivariate effect of maternal education with respect to negative emotional functioning (*Pillai's V*= .236, F(12, 288) = 2.05, p =.020). Univariate effects were found for anxiety (F(3, 101) = 2.87, p = .040) and somatic symptoms (F(3, 101) = 3.31, p = .023). Post-hoc LSD tests found that mothers with a high school education had children with higher self-reported anxiety than mothers with a bachelor degree (p = .035) and that mothers with a graduate degree had children with higher self-reported anxiety than mothers with a bachelor degree (p = .024). In addition, mothers with a college/technical degree had children who reported more somatic symptoms than mothers with a bachelor degree (p = .033).

The last set of preliminary analyses concerned possible differences in temperament and emotional functioning due to experimental session. There was no multivariate effect of session (*Pillai's V* = .145, F(10, 286) = 2.23, p =.917) for negative emotional functioning. When age was controlled, a session effect was found for child-reported BAS (F(2, 172) = 6.35, p = .002), such that children tested in session 1 reported higher levels of BAS than children in session 2 (p = .005) but not children tested individually in the lab. The differences between children tested individually and in groups could not be tested because of sample size issues. There were no session effects in relation to parent-reported temperament.

Primary Measures

Means, sample sizes, standard deviations, scale ranges and reliability coefficients for emotion and temperament questionnaire data is provided in *Table*

2. Preliminary analyses carried out for the primary measures (somatic complaints and temperament) are included below.

Table 2:   Descriptive statistics for temperament and emotion study variables

Study Variables	Descriptive Statistics				
	N	*M*	*SD*	*Scale Range*	*α*
Socio-emotional Measures					
Somatic complaints	177	7.19	5.96	0 - 90	.79
Anxiety	174	9.28	4.96	0 – 30	.71
Depressive Symptoms	175	2.81	2.72	0 – 20	.74
Positive Affect	172	3.19	0.71	1 – 5	.86
Negative Affect	172	1.68	0.55	1 – 5	.85
Temperament Measures					
Child-reported BIS	176	1.49	0.54	0 – 3	.63
Child-reported BAS	176	1.74	0.49	0 – 3	.80
Parent-reported BIS	85	4.72	0.88	1 – 7	.62
Parent-reported BAS	85	5.16	0.77	1 – 7	.83
Parent-reported SP	80	2.85	0.74	1 – 5	.87
Parent-reported SR	80	3.09	0.60	1 – 5	.84

Somatic Complaints. The total number and intensity of somatic symptoms that children endorsed were computed to better understand the distribution of somatic symptoms in the current sample. Using the criteria set out by Garber et al. (1991), the number of symptoms that children rated as bothering them "a lot" and "a whole lot" were summed. Scores ranged from 0 – 6 and the mean score was 0.46. A majority of children (75%) reported no symptoms and only 2.3% (*n* = 4) reported four or more symptoms. As noted earlier, this symptom threshold has differentiates children with and without internalizing difficulties (Escobar et al., 1987). The values obtained in the current study were considerably lower than reported in both the Escobar et al. and Garber et al. samples.

Building on work suggesting that Asian children tend to report somatic symptoms at a similar rate but lower in intensity (endorsing items as bothering them "a little" or "some" vs. "a lot" or "a whole lot"), new somatic symptom frequency scores were calculated by counting each non-zero response (i.e., child did not endorse this symptom at all) as one symptom (Lee, 2004). Scores ranged from 0 to 16 out of a possible 18. The distribution of reported symptoms is displayed in *Figure 1*. The number of children who reported ≥ 4 symptoms using this new criteria was 63.3% ($n = 111$).

A somatic symptoms total score was calculated by summing the values of all endorsed somatic symptoms. A graphical display of the distribution of these scores is provided in *Figure 2*. The average total score was 7.19 and values fell in between 0 and 35. The median total score was 6. This total score was used as the main outcome variable for all primary analyses.

Figure 1:   Number of somatic symptoms reported
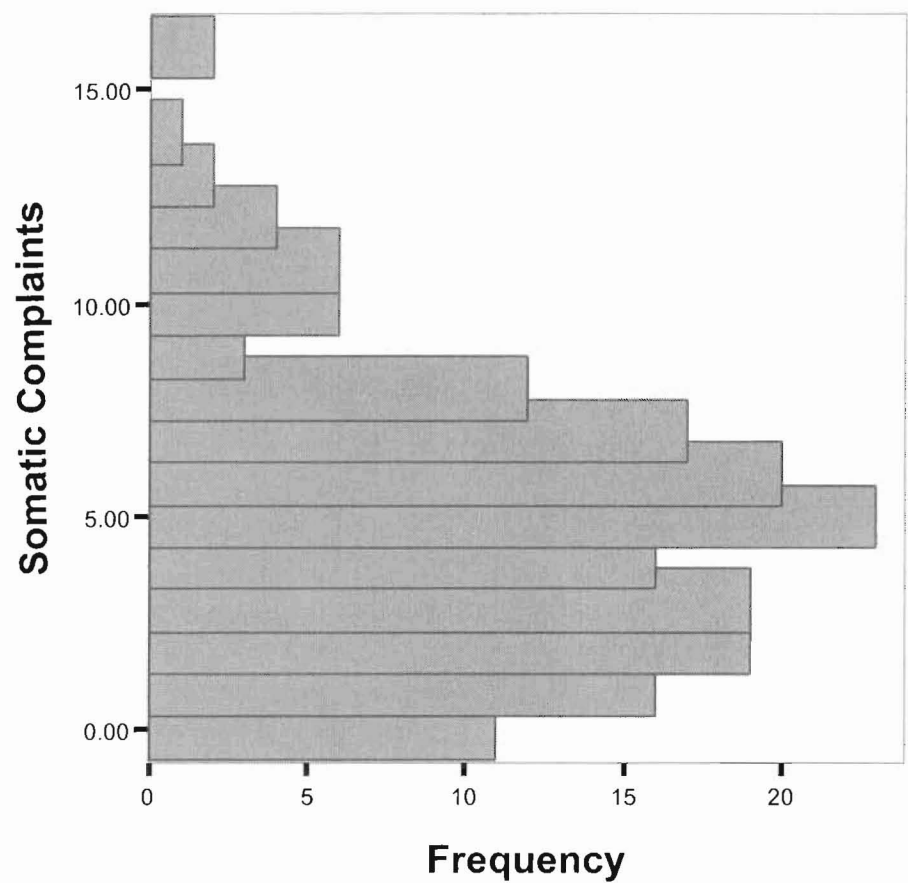
Figure 2: Distribution of somatic symptoms (total score)
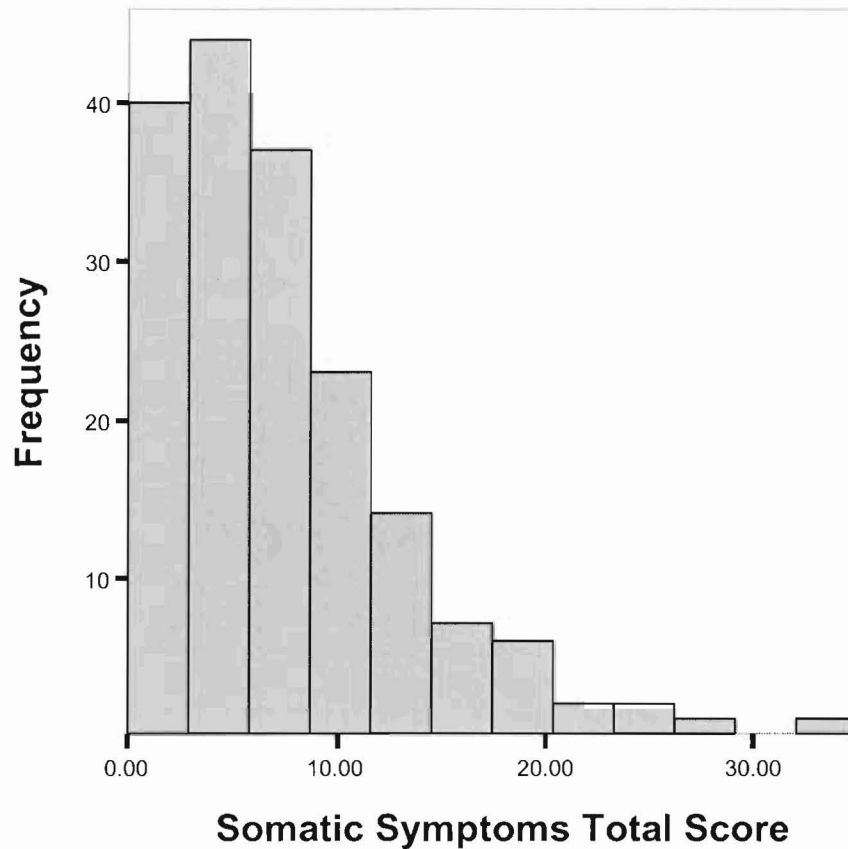
In contrast to results reported elsewhere (Garber et al., 1991), no gender or age differences were found on the CSI. Correlations between the CSI intensity score and the other socio-emotional measures is provided in *Table 3*. Statistically significant positive correlations were found for depressive symptoms, negative affect, and anxiety. The correlation between CSI and anxiety remained significant after the items inquiring about the somatic aspects of anxiety on the *MASC-10* were removed from the anxiety total score. When the Holm step-down procedure was used to control for Type I errors all correlations remained significant.

Table 3: Correlations between somatic symptoms total score and internalizing problems

Emotional Measures	Somatic complaints (CSI total score)	
	r	*p value*
Anxiety	*.370*	.000
Anxiety (somatic items removed)	*.313*	.000
Depressive Symptoms	*.220*	.003
Negative Affect	*.289*	.000
Positive Affect	.063	.410

Note: *p* values provided are the actual p-values. Significance values were also computed using the Holm step-down procedure; where $p_1 = p_1*k$, $p_2 = p_2*k-1$, ... *p values* < .05 by this criteria are **bolded** and *italicized*.

Temperament Measures. Means, standard deviations, scale ranges, sample sizes and reliability coefficients of each temperament measure can be found in *Table 2*. The internal reliability of all measures of approach and avoidance were found to be acceptable or good. However, the BIS (and SP) measures appear to be less reliable than BAS in the current sample. Bivariate pearson product moment correlations indicated a moderate association between BIS and BAS within the child-report of BIS and BAS (*r* = .305, *p* = .000) and parent-report of BIS and BAS (*r* = .299, *p* = .005), but not the parent-report of SP and SR (*r* = .073, *p* = .517). This association was controlled for in all analyses involving child and parent reported BIS and BAS by entering the appropriate measure as a covariate. As noted above, gender differences were found for child-reported BIS only. In the current sample, younger children rated themselves as higher in BAS. This association was not consistent across measures, as age was not significantly related to parent-reported BAS (*r* = -.086, *p* = .439) or sensitivity to reward (*r* = -.165, *p* = .145).

The concordance between parent and child measures of avoidance and approach is examined in *Table 4*. When no correction for type I error was made, both parent measures of avoidance temperament and approach temperament

were positively correlated. Child-reported BAS was significantly correlated with parent-reported BAS and sensitivity to reward (SR). Child-reported BIS, however, was not significantly related to either parent-reported BIS or SP. When the Holm step-down procedure for controlling type I error was used, significant associations remained between child-reported BIS and BAS and parent-reported BAS and SR. Level of agreement within the approach and avoidance constructs was also assessed via intra-class correlation coefficients (ICC) using a two-way mixed effects model. Measures of avoidance (i.e., child BIS, parent BIS, parent SP) had an ICC of -.031 (single measure; -0.098 for an average measure). Measures of approach (i.e., child BAS, parent BAS, parent SR) had an ICC of .37 (single measure; 0.64 for an average measure). This pattern of results suggests that (1) measures of approach seem to be more consistent and reliable across reporters, and (2) parents ratings of avoidance are consistent across the parent-report measures but are not concordant with child ratings on the BIS/BAS Scales child-report.

Table 4: Correlations between child and parent report measures of temperament

	Child & Parent-report measures of temperament					
	Child BIS	Child BAS	Parent BIS	Parent BAS	Parent SP	Parent SR
Child-reports						
BIS	---					
BAS	*.305****	---				
Parent reports						
BIS	-.029	-.075	---			
BAS	-.078	.218*	.299**	---		
SP	.088	-.143	.250*	-.173	---	
SR	.080	.223*	.110	*.585****	.073	---

Note: sample sizes can be found in *Table 2*.
*** correlations are significant at the p < .001 without correction for type I error; ** correlations are significant at the p < .01 without correction for type I error; * correlations are significant at the p < .05 without correction for type I error.
Italicized and bolded correlations remain significant when the Holm step-down procedure was used to control for type I error.

Point Scoring Reaction Time Task (PSRT). To verify the validity of the PSRT as an index of avoidance temperament and approach temperament in the current study several analyses were conducted. First, accuracy rates (i.e., how many mistakes children made in determining whether a number was odd or even) were calculated and analysed. Children who were highly inaccurate (< 70% accuracy rate) were removed from the dataset to ensure that children who were inattentive or did not understand the math problems would not disproportionately influence the mean reaction times. Fourteen children were excluded using this standard. While this criterion is more stringent than the 60% criterion used by Colder and O'Connor (2004), it was selected to lessen the chances of making analytical or inferential errors. Responses less than 250ms were excluded from analyses as these were considered anticipations. Non-responses were coded as the length of the trial (3500ms).

Consistent with past use of the PSRT, it was hypothesized that reaction times to reward trials in the punishment block would be slower than the pre-punishment block for all participants because of the introduction of the punishing stimuli. It was also expected that reaction times to all trials in the post-punishment block would be slower due to the conditioning effect of the punisher in the punishment trial. A repeated measures ANOVA was performed to compare the reaction times (RTs) in the three conditions. The condition main effect was significant $F(1, 145) = 30.39$, $p < .000$ and pairwise comparisons with a Bonferroni correction indicated the expected differences in RTs. Reaction times for the punishment block were slower than both the pre-punishment block ($p = .000$) and post-punishment block ($p = .000$). It was also predicted that in the post-punishment block, RTs for red trials would be slower than for non-red trials. A paired-samples t-test demonstrated a significant difference between non-red and red RTs, $t = -6.74$, $p < .000$. This pattern of results suggests that the point scoring reaction time task used in the current study showed reaction time effects consistent with previous studies of the paradigm (Avila, 2001; Colder & O'Connor, 2004). *Figure 3* provides a graphical display of mean RTs for each experimental block.

Figure 3:   Reaction times (ms) across PSRT blocks and trials for all children
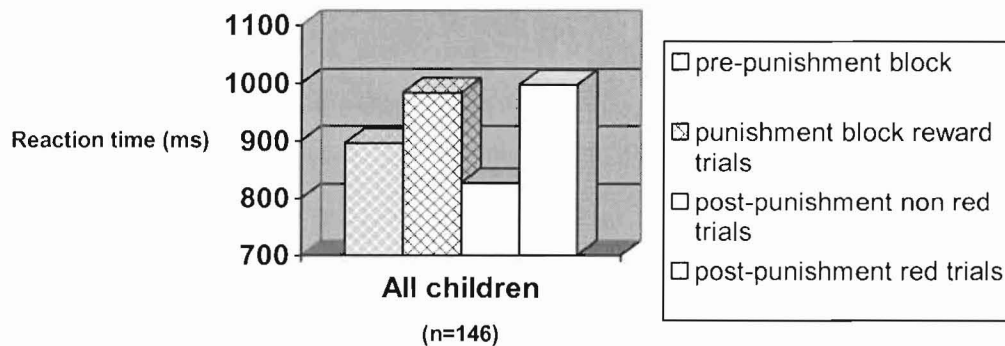
Associations between the computer task and demographic characteristics were also explored. An analysis of variance (ANOVA) was run to examine possible differences in reaction time due to age. A main effect of age was found for pre-punishment block reward RTs ($F(2, 145) = 36.66$, $p = .000$), punishment block reward RTs ($F(2, 145) = 19.94$, $p = .000$), post-punishment non-red trial RTs ($F(2, 145) = 22.01$, $p = .000$) and post-punishment red trial RTs ($F(2, 145) = 13.56$, $p = .000$). Post-hoc Bonferroni tests revealed that for every block children 10 years and under had slower RTs than both children aged 10-12 and 13 and above (all p's $= .000$). Children aged 10-12 years also showed slower reaction times than children aged 13 and above for all blocks (p's ranged from .002 to .031), except the post-punishment block red trials. However, when difference scores were analysed (*punishment*: pre-punishment – punishment; *reward*: non-red – red trials), age was only correlated with the reward difference score ($r = -.183$, $p = .027$). There were no differences in RTs due to gender or maternal education. There were however differences in RTs due to parental birthplace. Specifically, there was a main effect for parental birthplace with respect to prepunishment reward RTs ($t(98) = -2.31$, $p = .023$), punishment block reward

RTs (t(98)=-2.83, p = .006) and post-punishment non-red trial RTs (t(98) = -2.12, p = .037). In particular, children from North American/European born parents had longer reaction times in these three blocks. No effect was found for post-punishment block red trial RTs (t(98) = -1.35, p = .181).

The possibility of session effects on RTs was also examined. A significant main effect of session was found for punishment block reward RTs (F(2, 145) = 4.36, p = .014). Bonferroni post-hoc comparisons found that those children tested individually had longer reaction times in the punishment block reward trials than children tested as a group in the summer of 2006 (p = .019). There were no differences between the two summer sessions or individually tested children and children tested in the summer of 2007.

Finally, the relation between the PSRT and questionnaire measures of avoidance and approach was also tested. Regression analyses were performed to better understand the association between each measure of temperament and (1) the difference between RTs in the pre-punishment block and the reward trials of the punishment block, and (2) the difference between RTs for the non-red and red trials of the post-punishment block. Difference scores were calculated (see above) and used as the DV. It was expected that indices of approach would predict less slowing from pre-punishment to punishment blocks and avoidance would predict more slowing from non-red to red trials in the post-punishment block. Graphical representations of these hypotheses are provided in *Figures 4 and 5*. Type I error was controlled in each regression analysis using the Holm step-down procedure.

Figure 4: Conceptually expected increases in reaction time for children high and low in sensitivity to reward
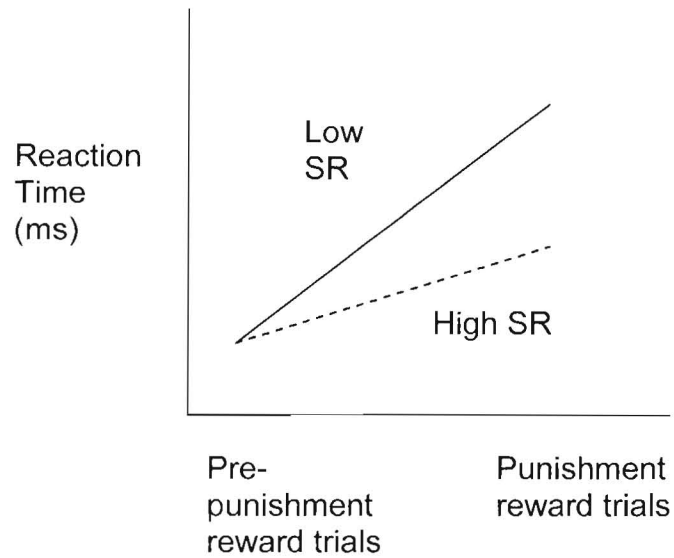
Figure 5: Conceptually expected increases in reaction time for children high and low in sensitivity to punishment
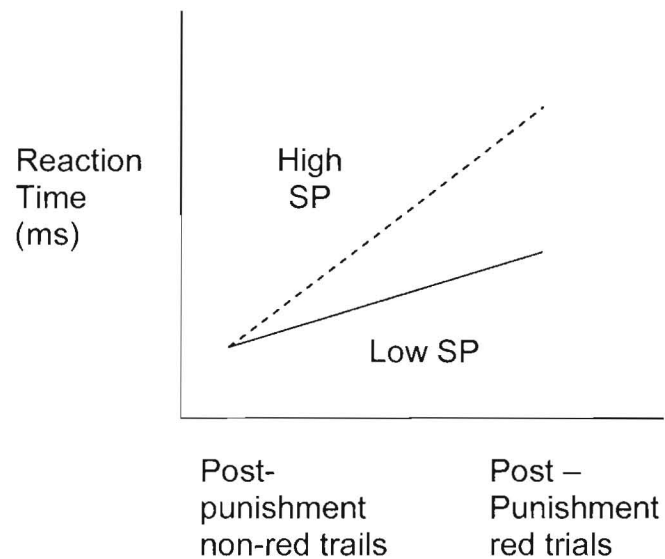
BIS, BAS and the interaction of BIS and BAS were entered simultaneously to examine the relation between the PSRT and child-reports of BIS and BAS. When the punishment difference score was entered as the DV, results indicate that neither BIS (β = .004, p = .966), BAS (β = .058, p = .513), or the interaction (β = -.153, p = .079) were significant predictors of the punishment difference score on the PSRT. The full model was not significant (F(3, 138) = 1.42, p = .240, R^2 = .031). When the reward difference score was entered as the DV, the full model was also not significant (F(4, 143) = 1.71, p = .150, R^2 = .047) and age (β = -.200, p = .019) was the only significant independent predictor (BIS β = -.015, p = .864; BAS β = -.090, p = .313; BIS x BAS β = -.063, p = .470). Age was not a significant predictor when type I errors were controlled.

Separate hierarchical regressions utilizing parent-reported BIS and BAS as IVs revealed the same pattern of results. The full model was not significant (F(3, 70) = .042, p = .737, R^2 = .019) and BAS (β = .106, p = .411), BIS (β = -.124, p = .365) and the interaction of BIS and BAS (β = -.064, p = .628) did not explain significant variability in punishment difference scores. When reward difference scores were examined, none of the predictors explained significant variability (Age β = -.026, p = .834; BIS β = -.110, p = .412; BAS β = -.048, p = .707, BIS x BAS β = -.061, p = .640) and the model was not significant (F(4, 71) = 0.28, p = .892, R^2 = .016).

The last set of regressions examined parent-reported SP and SR as predictors of reward and punishment difference scores. SP (β = -.044, p = .731), SR (β = .242, p = .069) and the interaction (β = .009, p = .945) were not significant predictors of the punishment difference score and the full model was not significant (F(3, 65) = 1.27, p = .293, R^2 = .058). When reward difference scores were entered as the DV, SR was not a significant predictor (β = -.212, p = .111). The effect of SP (β = .019, p = .898) was non-significant as was the interaction (β = -.143, p = .300). The SR impulsivity/fun seeking scale was also used as a predictor of reward difference scores. This is the scale that Colder and O'Connor found predicted reactivity to reward. It was not a significant predictor (β = -.139, p = .266).

These analyses demonstrate that the computer task did have the desired effect of (1) increasing reaction times for punishment block trials compared to pre-punishment block trials and (2) increasing reaction times to red circle trials compared to non-red circle trials across all participants. However, approach and avoidance temperament did not show the expected relations with the difference scores for both parent and child-reports.

Additional exploratory analyses were done to better understand the non-significant relations between approach-avoidance temperament and the PSRT. As can be seen in *Figure 6*, parent-reported SP and SR had the best explanatory power of all the temperament indices. Children categorized as high in SP (>1 SD above mean) showed the expected difference in RT scores in the post-punishment block (i.e., there was a greater decrease in reaction time for red circle trials for these children compared to all children). This difference however was not large enough to be statistically significant. Parent reported high BIS and child reported high BIS demonstrated mean decreased RT but this did not exceed the mean RT decrease for all children. With respect to reward difference scores, children rated as high in approach did not show the expected reduced differences in reaction times from pre-punishment to punishment when compared to all children (see *Figure 7* for a graphical display). In fact, results show the opposite effect.

Figure 6:   Mean RT differences between non-red and red trials in children >1 SD above the mean on each avoidance temperament measure
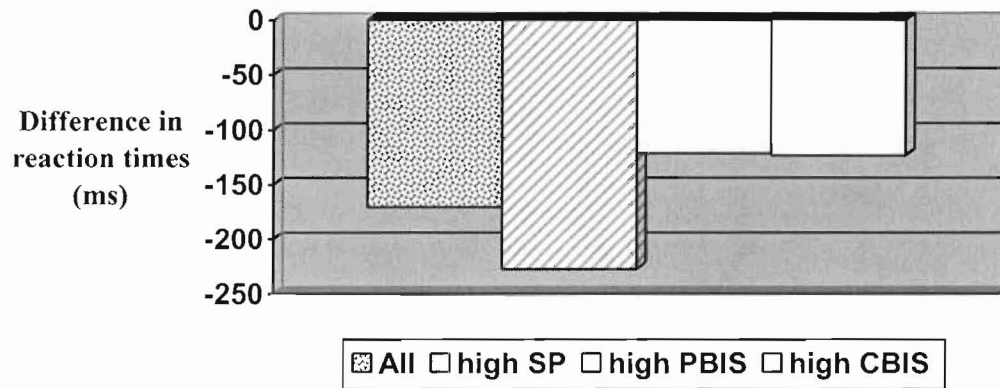
Figure 7:   Mean RT differences between pre-punishment and punishment reward trials in children >1 SD above the mean on each approach temperament measure
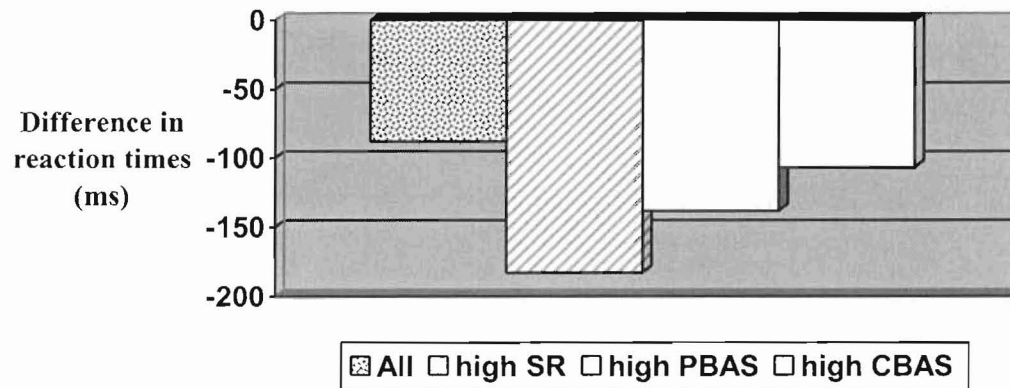
Main Analyses

Avoidance Temperament

The main hypothesis of the study was that avoidance temperament would be positively related to somatic complaints. Secondarily, it was predicted that emotional distress would mediate the relation between avoidance temperament and somatic complaints because it is more proximally related to somatic complaints. Baron and Kenny (1986) have specified four conditions necessary for testing mediation. First, the IV must be related to the mediator. Second, the IV needs to be related to the DV. Third, the mediator should be also be associated with the DV. Lastly, when the effects of the mediator are controlled, the association between the IV and DV should either become non-significant (full mediation) or reduced significantly (partial mediation) but still related. As such, it was hypothesized that (a) consistent with the literature, avoidance temperament will be positively associated with internalizing problems, (b) avoidance temperament and internalizing problems will be independently and positive related to somatic complaints and (c) after controlling for emotional distress, avoidance will no longer be significantly associated with somatic complaints.

To test these hypotheses, a set of correlations and regressions were performed. First, avoidance temperament was correlated with anxiety, negative affect and depressive symptoms. Partial correlations were calculated for child-and-parent-reported BIS and BAS because of the modest correlations found in the preliminary analyses. These results are displayed in *Table 5*. When controlling for BAS, child-reported BIS was significantly positively correlated with anxiety, depressive symptoms, and negative affect. Parent-reported BIS and SP were not related to any of the internalizing measures.

Table 5:   Correlations between child and parent report measures of avoidance temperament and internalizing problems

Emotion Measures	Child & Parent-report measures of temperament		
	Child BIS[1]	Parent BIS[2]	Parent SP
Anxiety	*.426******	.122	.187
Depressive Symptoms	*.232****	-.065	.092
Positive Affect	-.013	-.091	-.202
Negative Affect	*.383******	-.049	.058

Subscripts: 1 = child BAS controlled; 2 = parent BAS controlled
Note: Significance values computed using Holm step-down procedure; where $p_1 = p_1{}^*k$,
$p_2 = p_2{}^*k-1$, ...p *values* < .05 are significant. They are *italicized* and bolded here.

Next, to test hypothesis 1(b), somatic complaints was regressed on each measure of avoidance temperament in separate regressions. These results are displayed in *Table 6*. As expected, avoidance temperament was positively related to somatic complaints. However, the regressions indicate that only child-reported BIS was significantly and positively associated with somatic complaints. Parent-reported BIS and SP did not significantly predict somatic complaints nor did the punishment difference score derived from the PSRT.

Table 6:   Somatic complaints regressed on each measure of avoidance temperament

Models & Predictors	Regression Coefficients			
	R^2	β	p	p_1
Avoidance Temperament				
Child-reported BIS	*.066*	*.256*	*.001*	*.004*
Parent-reported BIS	.004	.063	.567	---
Parent-reported SP	.001	-.035	.762	---
PSRT punishment difference score	.001	-.035	.676	---

Note: Significance values computed using Holm step-down procedure; where $p_1 = p_1*k$, $p_2 = p_2*k-1$, …p values < .05 are significant. They are *italicized* and bolded here.

To test the hypothesis that emotional distress would be independently and positively associated with somatic complaints, another set of regression analyses were performed. Somatic complaints total score was regressed on anxiety, negative affect and depressive symptoms in separate regressions. The items on the anxiety scale related to somatic concerns were removed to eliminate shared variability. All measures of emotional distress were significantly and positively associated with somatic complaints. Anxiety independently explained the most variability in somatic complaints ($F_{(1, 172)}$ = 19.06, R^2 = .100, β = .317, p = .000). Negative affect explained 8.4% of the variability in somatic complaints ($F_{(1, 170)}$ = 15.41, β = .289, p = .000) and depressive symptoms explained 5.4% ($F_{(1, 173)}$ = 9.91, β = .233, p = .000). These associations remained significant even after using a Holm step-down correction procedure to protect against type I error.

Following this analysis, a decision was made to eliminate depressive symptoms from subsequent mediation analyses because (1) it explained the least amount of variability in somatic complaints and (2) it is often conceptualized as being a derivative of intense negative emotions (Clark & Watson, 1991; Clark et al., 1994; Tellegen, 1985). Negative emotions are also more directly related to

Gray's model and therefore are arguably more fundamental. Furthermore, including a test of the predictive ability of depressive symptoms would unnecessarily inflate the type I error rate.

To test the prediction that avoidance temperament would not be related to somatic complaints after controlling for anxiety and negative affect (hypothesis 1c) a last set of regressions were performed. Somatic complaints were regressed on (1) anxiety and child-reported BIS, and (2) negative affect and child-reported BIS. These results are also presented in *Table 7*. Results support hypotheses. Anxiety predicted somatic complaints when BIS was in the model (β = .253, p = .002) and the reduction of the beta coefficient for BIS when anxiety was in the model (β = .133, p = .108) was significant, (sobel *z-value* = 2.80, p = .005), suggesting full mediation. In addition, negative affect predicted somatic complaints when BIS was in the model (β = .229, p = .003). The reduction of the beta coefficient for BIS when negative affect was in the model was also significant, (sobel *z-value* = 2.55, p = .011), suggesting partial mediation. All regressions with a significant *p-value* remained significant when type I error was controlled using the Holm step-down procedure.

Table 7: Results of regressions for mediation analyses

Models & Predictors	Regression Coefficients				
	R^2	β	SE	p	p_1
***Anxiety*[1]**					
Avoidance => somatic complaints	*.064*	*.252*	*.132*	*.001*	*.003*
Avoidance => anxiety	*.224*	*.474*	*.556*	*.000*	*.000*
Anxiety => somatic complaints	*.100*	*.317*	*.016*	*.000*	*.000*
Anxiety + Avoidance => somatic complaints	.113			*.000*	*.000*
(a) Anxiety		*.253*	*.018*	*.002*	*.004*
(b) Avoidance		.133	.147	.108	---
***Negative Affect*[2]**					
Avoidance => somatic complaints	*.066*	*.256*	*.134*	*.001*	*.003*
Negative Affect => somatic complaints	*.084*	*.289*	*.231*	*.000*	*.000*
Avoidance => negative affect	*.154*	*.393*	*.041*	*.000*	*.000*
Negative affect + avoidance => somatic complaints	*.103*			*.000*	*.000*
(a) Negative Affect		*.229*	*.249*	*.005*	*.01*
(b) Avoidance		.152	.143	.059	.059

Subscripts: 1: N = 172; 2: N = 170
Note: Significance values computed using Holm step-down procedure; where p_1 = p_1*k,
p_2 = p_2*k-1, ...*p values* < .05 are significant. They are *italicized* and bolded. Original *p-values*
are represented in the column labelled *p*.

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Separate analyses were done for male and female children because of the gender difference in child-reported BIS noted in the preliminary analyses. Only child-reported BIS was used to predict somatic complaints, as it was the only measure of avoidance temperament that was significantly associated with somatic complaints in the original regressions.

Results of regression analyses testing the hypothesis that anxiety mediates the association between avoidance temperament and somatic complaints for boys and girls are presented in *Table 8*. As can be seen, BIS explained significant variance in somatic complaints for boys ($F(1, 85) = 10.15$, $R^2 = .109$, $p = .002$, $\beta = .330$). Mediation analyses demonstrated that anxiety was a full mediator for male children (sobel z-value = 2.17, p = .030). In other words, when anxiety was controlled, avoidance no longer predicted somatic complaints in boys. The mediation analyses are presented in *Figure 8*. For girls, BIS was significantly and positive related to somatic complaints ($F(1, 88) = 4.61$, $R^2 = .051$, $p = .035$, $\beta = .225$). Mediation analyses indicated that anxiety was not a mediator of the association between avoidance and somatic complaints in girls (sobel z-value = 1.79, p = .072). This relationship can be found in *Figure 9*. Anxiety was an independent predictor of somatic complaints, but when BIS was added to the model, neither were significant predictors. After controlling for type I error using the Holm step-down procedure, the regression coefficients remained significant for the boys, but BIS became a non-significant predictor of somatic complaints for girls.

Table 8:   Results of regressions for mediation analyses by gender - anxiety

Models & Predictors	Regression Coefficients				
	R^2	β	SE	p	p_1
Males[1]					
Avoidance => somatic complaints	*.109*	*.330*	*.173*	*.002*	*.006*
Avoidance => anxiety	*.221*	*.470*	*.872*	*.000*	*.000*
Anxiety => somatic complaints	*.136*	*.369*	*.019*	*.001*	*.005*
Anxiety + Avoidance => somatic complaints	*.168*			*.001*	*.004*
(a) Anxiety		*.275*	*.021*	*.019*	*.038*
(b) Avoidance		.201	.191	.084	.084
Females[2]					
Avoidance => somatic complaints	**.051**	**.225**	**.210**	**.035**	.105
Avoidance => anxiety	*.218*	*.467*	*.750*	*.000*	*.000*
Anxiety => somatic complaints	*.080*	*.283*	*.026*	*.008*	*.04*
Anxiety + Avoidance => somatic complaints	**.091**			**.017**	.068
(a) Anxiety		.227	.030	.056	.112
(b) Avoidance		.119	.234	.312	.312

Subscripts: 1: N = 84; 2: N = 88.
Note: Significance values computed using Holm step-down procedure; where $p_1 = p_1{}^*k$, $p_2 = p_2{}^*k$-1, ...p values < .05 are significant. They are bolded and *italicized* here.
Values that are bolded but not italicized are significant without the Holm correction.

Figure 8:   Anxiety a full mediator for boys
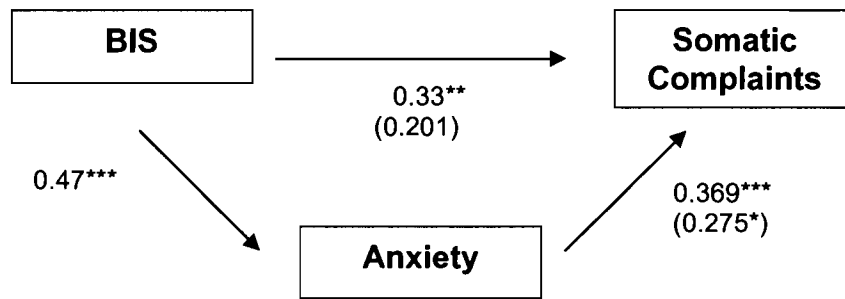
| BIS | 0.33**
(0.201) | Somatic Complaints |

0.47***

Anxiety

0.369***
(0.275*)

Note: *** p<.001, ** p<.01, *p<.05
( ) indicates reduction of β when other relationships are taken into account

Figure 9:   Anxiety not a mediator for girls

| BIS | 0.225*
(0.119) | Somatic Complaints |

0.467***

Anxiety

0.283*
(0.227*)

Note: *** p<.001, ** p<.01, *p<.05
( ) indicates reduction of β when other relationships are taken into account

The regression analyses testing the hypothesis that negative affect mediates the association between avoidance temperament and somatic complaints for boys and girls are in *Table 9*. For boys, child-reported BIS was a significant predictor (β = .306, p = .005) of somatic complaints, as was negative affect (β = .222, p = .044). The association between BIS and somatic complaints remained significant with negative affect in the model (sobel *z-value* = 1.15, p = .25), indicating no mediating effect of negative affect. Relations are presented in *Figure 10*. For girls, child-reported BIS (β = .225, p = .036) and negative affect (β = .351, p = .001) were both significant independent predictors of somatic complaints. The reduction in the beta value for BIS was significant when negative affect was in the model (sobel *z-value* = 2.34, p = .019), suggesting full mediation. *Figure 11* is a graphical representation of these associations. When type I errors were controlled using the Holm step-down procedure, negative affect was no longer related to somatic complaints for boys and avoidance was not associated with somatic complaints for girls. This indicates that when stringent type I error control is applied, there is no justification for a mediation model of negative affect for both girls and boys.

In summary, the regression analyses demonstrate that avoidance temperament is in fact significantly and positively associated with emotional distress and somatic complaints. Anxiety and negative affect both mediate the relation between avoidance temperament and somatic complaints. However, these associations mask interesting gender differences. In particular, it appears as if negative affect is a mediating variable for girls but not for boys, while anxiety is a mediating variable for boys but not girls.

Table 9: **Results of regressions for mediation analyses by gender – negative affect**

Models & Predictors	Regression Coefficients				
	R^2	β	SE	p	p_1
Males					
Avoidance => somatic complaints	*.094*	*.306*	*.181*	*.005*	*.025*
Negative Affect => somatic complaints	*.049*	*.222*	*.358*	*.044*	.088
Avoidance => negative affect	*.100*	*.317*	*.054*	*.004*	*.024*
Negative affect + Avoidance => somatic complaints	*.111*			*.009*	*.036*
(a) Negative Affect		.139	.367	.215	---
(b) Avoidance		*.262*	*.190*	*.021*	.063
Females					
Avoidance => somatic complaints	**.051**	**.225**	**.207**	**.036**	.072
Negative Affect => somatic complaints	*.123*	*.351*	*.307*	*.001*	*.005*
Avoidance => negative affect	*.188*	*.434*	*.064*	*.000*	*.000*
Negative affect + Avoidance => somatic complaints	*.130*			*.003*	*.012*
(a) Negative Affect		*.312*	*.341*	*.007*	*.021*
(b) Avoidance		.090	.222	.427	---

Subscripts: 1: N = 83; 2: N = 87.

Note: Significance values computed using Holm step-down procedure; where $p_1 = p_1{}^*k$, $p_2 = p_2{}^*k$-1, ...p values < .05 are significant. They are *italicized* and **bolded** here. **Bolded** values are significant without the correction but not significant with the correction.
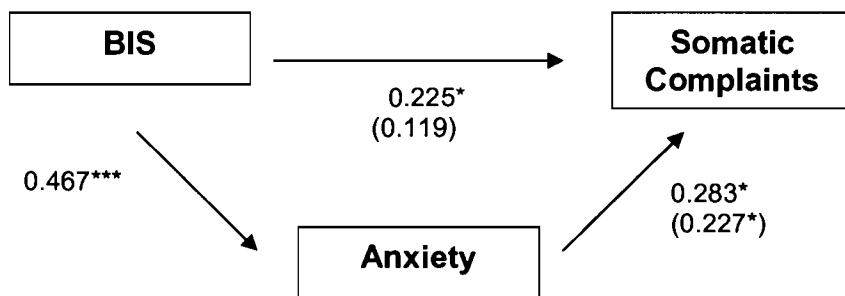
Figure 10: Negative affect a mediator for girls
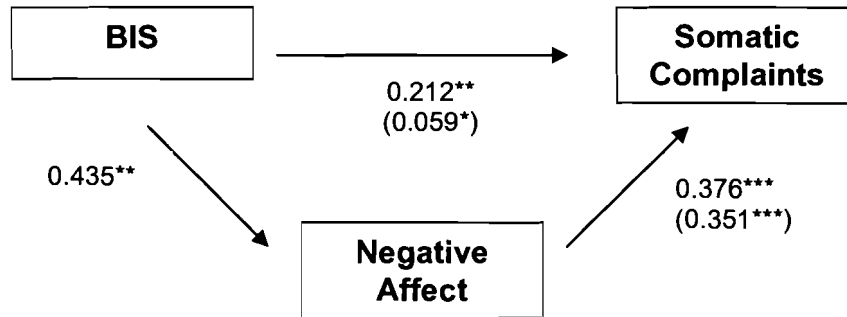
Note: *** p<.001, ** p<.01, *p<.05
( ) indicates reduction of β when other relationships are taken into account

Figure 11: Negative affect not a mediator for boys
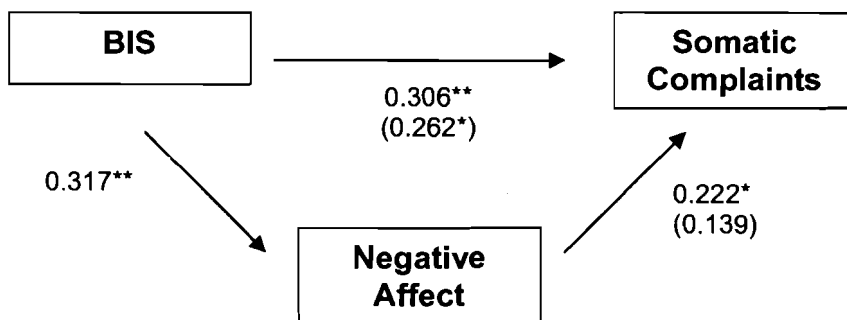
Note: *** p<.001, ** p<.01, *p<.05
( ) indicates reduction of β when other relationships are taken into account

Approach Temperament

The second set of hypotheses concerned the relationship between approach temperament and somatic complaints. It was predicted that approach temperament would be significantly and negatively associated with somatic complaints. It was further hypothesized that positive emotions would mediate the association between approach temperament and somatic complaints. To demonstrate this, it was expected that (1) approach temperament would be associated with both positive emotions and somatic complaints, (2) positive emotions would be related to somatic complaints, and (3) when positive emotions were controlled, approach temperament would no longer be associated with somatic complaints. In addition to these predictions, it was hypothesized that approach temperament might be non-linearly related to measures of emotional distress. Theoretical arguments to this effect have been made in previous research but never tested. Because subsequent analytical methods depend on the type of relationship between approach and internalizing measures, these analyses were run first.

A set of linear, quadratic and cubic curve estimations were fitted to the data using regression. Child-reported BAS was entered as the independent variable and each measure of internalizing as individual DV's. None of the regression lines fit the association between anxiety, negative affect or somatic complaints and child-reported BAS. The linear, quadratic and cubic regression equations significantly explained the relation between depressive symptoms and BAS. However, the most parsimonious explanation was the linear one ($F(1, 172)$ = 7.55, R^2 = .042, p = .007). According to this solution, as BAS increases, levels of depressive symptomatology decrease (r = -.267, p = .000). As expected, the linear association between BAS and positive affect was the best fit ($F(1, 169)$ = 29.16, R^2 = .147, p = .000). The partial correlation indicated a moderate relation, r = .364, p = .000. When both parent-reported BAS and SR were considered, none of the regression equations significantly explained the associations with the emotion measures. Thus, there does not seem to be any relation between

parent- reported approach temperament and children's emotional functioning. Pearson product moment correlations are shown in *Table 10*.

Table 10: Correlations between measures of approach temperament and emotional functioning

Emotion Measures	Child & Parent-report measures of temperament		
	Child BAS^1	*Parent BAS^2*	*Parent SR*
Anxiety	-.104	-.126	-.009
Depressive Symptoms	*-.292*****	-.063	.059
Positive Affect	*.384*****	-.024	-.119
Negative Affect	-.013	-.022	-.003

Subscripts: 1 = child BIS controlled, 2 = parent BIS & age controlled.
*** Correlations are significant at the p < .01 after controlling for type I error using the Holm step-down procedure.

To determine whether approach temperament was significantly negatively associated with somatic complaints, four regressions were performed in which the somatic complaints total score was regressed on each measure of approach temperament. Results indicate that none of the approach temperament measures is significantly associated with somatic complaints. Due to this, it was not necessary to run further regressions to test the predicted mediation model.

Table 11: Somatic complaints regressed on approach temperament

Models & Predictors	Regression Coefficients			
	R^2	β	p	p_1
Avoidance Temperament				
Child-reported BAS	.012	.108	.154	---
Parent-reported BAS	.004	.061	.582	---
Parent-reported SR	.013	-.113	.324	---
PSRT reward difference score	.001	.028	.740	---

Note: Significance values computed using Holm step-down procedure; where $p_1 = p_1{}^*k$, $p_2 = p_2{}^*k$-1, ...p values < .05 are significant.

Approach-Avoidance Temperament

As an additional piece, it was predicted that different levels of avoidance and approach temperament would differentially predict somatic complaints in children. Based on previous research documenting the most negative psychosocial outcomes for children high in BIS and low in BAS, it was hypothesized that these children would have the highest somatic complaints score. To test this hypothesis, the interaction of approach and avoidance for each measure of temperament was entered in a separate regression. None of the interaction terms were related to somatic complaints. The interaction of child-reported BIS and BAS did not predict somatic complaints (β = -.035, p = .650), nor did parent-reported BIS and BAS (β = .033, p = .765) or SP and SR (β = .093, p = .415).

DISCUSSION

The goal of this study was to examine the relation between approach and avoidance temperament and somatic complaints in children. It was hypothesized that avoidance temperament would be associated with increased levels of somatic complaints while approach temperament would be associated with decreased levels of somatic complaints. It was also expected that different combinations of approach and avoidance temperament might be differentially related to somatic complaints. Results partially support predictions. Avoidance temperament was associated with the reporting of more somatic complaints, but approach temperament and the interaction of approach and avoidance temperament was not. Additionally, it was predicted that internalizing problems would mediate the association between avoidance and somatic complaints. This hypothesis was supported, but differed in boys and girls. Positive emotions were also expected to mediation the association between approach temperament and somatic complaints, but this hypothesis could not be tested due to the non-significant relation between approach and somatic complaints.

Avoidance Temperament

In the current study, a significant association between avoidance temperament and somatic complaints was found. This demonstrates that Gray's BIS dimension, also labelled as sensitivity to punishment, may be an important construct to examine when looking at the temperamental correlates of somatic complaints. Children who rated themselves as higher on BIS also tended to report a greater frequency and intensity of somatic complaints. In addition, these increases were linear. These children also reported higher levels of anxiety, depressive symptoms and negative affect, a finding consistent with the literature. These are important findings because they add to a body of literature indicating that avoidance temperament may be related to negative health outcomes.

However, because children who scored high on BIS also reported more internalizing problems and these internalizing problems were also associated with higher somatic complaint scores, it not clear which variable is a more robust predictor and/or what processes or mechanisms underlie these associations. Chronic arousal, focusing of attentional resources, lack of conflict resolution, and prolonged exposure to negative emotions are all possible reasons why avoidance (and BIS) may be related to somatic complaints. However, the current study did not measure arousal, attention or conflict resolution.

One model attempting to clarify how avoidance is related to somatic complaints was tested in the current study. It was based on the argument that avoidance temperament predisposes children to internalizing difficulties, which may then make children more likely to have somatic complaints. It was predicted that once the effects of anxiety and negative affect were controlled, avoidance temperament would no longer be associated with somatic complaints. As such, anxiety and negative affect would mediate the relation between avoidance temperament and somatic complaints because they are more proximally related to somatic complaints. This model did not suggest that avoidance temperament is not important; rather, it implied that there would be a stronger relation between internalizing and somatic complaints because they are more directly related. This hypothesis was supported. The positive association between avoidance and somatic complaints was reduced when both anxiety and negative affect were controlled.

As outlined in the introduction, there is an abundance of literature documenting the relations between anxiety, negative affect and somatic complaints. In the case of anxiety, these results were predictable because it is often felt physically. Anxious feelings trigger the activation of the sympathetic branch of the autonomic nervous system (ANS) which then sends messages to various parts of the body (i.e., the respiratory, gastrointestinal, cardiovascular) that create changes in bodily functioning (i.e., increase heart rate, electrodermal response, cortisol increase). Thus, anxiety is often experienced physically, especially when it is extreme (e.g., panic attacks). The physiological effects of

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negative affect are not as clearly delineated, but are closely related to anxiety and can have similar effects. In fact, anxiety and negative affect are highly correlated constructs. In this study their correlation was high (r = .469, p = .000).

Additionally, according to Gray's theory, anxiety and chronic negative affect are subsidiary effects of avoidance temperament. Children may be predisposed to feel these emotions, especially in times of stress and perceived danger (real, imaginary, immediate, and anticipatory). The chronic arousal and biochemical cascade associated with these emotions may cause children to be hyper-sensitive to the function of their body and the environment around them. Alternatively, the regulation of these feelings may explain their effect on the body. Poorly regulated emotions may result in somatic expression because the conflict and arousal cannot be dissipated by other mechanisms. It is possible that the combination of poor regulatory ability associated with BIS and the experience of chronic negative emotions causes children to somatize. Again, the possible physical effects of these complex relationships need to be explored.

Perhaps the most interesting finding in the current study was that the association between avoidance and somatic complaints was quite different for boys and girls. Unfortunately, when the data was examined as a group, interesting and potentially informative gender differences were masked. When separate analyses were performed for boys and girls results showed that BIS appears to be a stronger predictor of somatic complaints in boys. This indicates that avoidance is more closely associated with somatic complaints for boys, whereas for girls other aspects of functioning may play a role. As such, the BIS/BAS scales child-report could be measuring a different domain of functioning in boys that is more directly relevant to the experience of somatic complaints. One may speculate that different subtypes of anxiety (e.g., general social avoidance, social avoidance in novel situations, specific anxieties, fear of negative evaluation) might be differentially related to somatic complaints in girls and boys and male children in the current sample might have reported lower functioning in these areas. The current investigation did not include measures that could separate the effects of specific aspects of anxiety. However, in a

recent study, Coplan et al. (2006) found that fear of negative evaluation and social avoidance to new situations and unfamiliar people as assessed by the Social Anxiety Scale for Children – revised (LaGreca, 1998) was most strongly associated with BIS (FNE $r = 0.48$; SAD-New $r = 0.42$). Further research examining the subtypes of anxiety that are more related to somatic complaints in children as well as possible gender differences is needed to clarify these findings.

Another interesting finding was that anxiety and negative affect differentially contributed to somatic complaints in females and males, suggesting that the correlates of somatic complaints in girls and boys are somewhat different. Both internalizing problems were related to more somatic complaints, but their relative importance was different. Specifically, anxiety seems to be more important than negative affect for boys and negative affect seems to be more important than anxiety for girls. Anxiety was a better predictor of somatic complaints than avoidance temperament in both genders, but was a stronger predictor for boys. This may partially explain why once the effects of anxiety were controlled; avoidance no longer predicted somatic complaints for boys. Anxiety was not a mediator for girls, likely because of the weak but significant relation between avoidance temperament and somatic complaints. With respect to negative affect, the relation between negative affect and somatic complaints for boys was not as strong as it was for girls. Consequently, once the effects of negative affect were removed, avoidance temperament did not predict somatic complaints for girls but did for boys. These results are particularly intriguing because gender differences in these variables or somatic complaints were not found. This pattern of results has not been reported elsewhere and thus warrants further examination.

One explanation for this is that male and female children might experience the same relative levels of these internalizing problems but express them differently. Boys may express anxiety somatically more so than negative affect and girls might express negative affect somatically more so than anxiety. It might also be important to consider these findings within the context of gender

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differences in the socialization of emotion regulation and expression. Research has illustrated that boys are implicitly encouraged by parents to inhibit fearful emotions while girls are encourage to inhibit strong negative emotions like anger (Casey, 1993). Likewise, it more acceptable for boys to express anger and girls sadness. Boys are also socialized to engage in more distraction and problem-solving strategies to regulate negative emotions (Block, 1983; Eisenberg et al., 1998; Fuchs & Thelen, 1988). This dysregulation could lead to somatic complaints via different pathways. It is possible that boys may express anxious feelings via somatic mechanisms whereas negative affect is better able to be expressed verbally or behaviorally. Additionally, boys may not be as adept at regulating anxious feelings and this may lead to somatic complaints. Similarly, it might be more acceptable for women to express anxiety, but not negative emotions, verbally and behaviourally. Girls may also be poor regulators of negative emotions because they are encouraged to inhibit strong negative emotions.

Also interesting to note is that gender differences in the frequency and intensity of somatic complaints were not found in the current study. This is in contrast to a well-established literature noting that females tend to report more somatic complaints than males, regardless of age (e.g., Escobar et al., 1987; Garber et al., 1991; Walker et al., 2001). Thus, this finding is both interesting and difficult to explain. There is a possibility that females may have been reluctant to report or that males over-reported, however there is no evidence to support this in the current study. The most parsimonious explanation is that male and female children did not actually differ on the number and intensity of reported somatic complaints. The reliability of this finding and its possible causes, is in need of further research.

Overall, these findings illustrate the importance of taking avoidance temperament into account when examining somatic complaints, but also highlight the need to do this within the context of internalizing problems, gender and the unique perspectives of different reporters. Furthermore, a firm argument in

support of the proposed temporal sequence obviously cannot be made because this study was correlational.

Approach Temperament

Contrary to the hypotheses, approach temperament was not significantly associated with somatic complaints in the current sample of children. This suggests that the tendency to approach stimuli, engage in behavioural facilitation and be sensitive to reward does not increase or decrease a child's vulnerability to somatize. It was predicted that the predisposition to experience positive emotions would somewhat protect children from experiencing somatic complaints. Consistent with the literature, BAS was negatively related to depressive symptoms and positively related to positive affect, but neither positive affect nor avoidance was significantly associated with more or less somatic complaints. Thus, both approach temperament and positive emotions may not be important in explaining why children do or do not have somatic complaints.

When the relationship between positive and negative emotions is considered these results fit. Positive emotions and negative emotions are not dichotomies; rather, they are each represented on separate dimensions. Thus, positive emotions are not the opposite of negative emotions, and having high levels of positive emotions does not mean that an individual will have low levels of negative emotions. For the current study, scoring high on positive emotions was not related to fewer complaints, perhaps because these emotions do not afford the same risks as negative emotions.

The predicted non-linear relationships between BAS and negative emotional functioning were also not supported. Increases in the level of child-reported BAS were accompanied by a linear decrease in depressive symptoms and no systematic change in anxiety and negative affect. These results could be due a misspecification of the BAS model such that extremely high levels are not indicative of poorer functioning. Rather, declines in functioning may be constant along the BAS dimension. While individuals with a high BAS have demonstrated

the most negative outcomes in terms of impulsivity addiction and aggression, no investigations have tested the possibility of non-linear associations. The linear relations found between BAS and depressive symptoms could reflect a restriction of range problem. In this case, both a linear and cubic fit to the data were significant, but the linear relationship was chosen as the "best" fit because of the lack of extreme BAS values to fit the tail ends of the cubic curve. In fact, there was a relatively low frequency of observations at the lower and higher ends of BAS and this may have limited the fit of the regression equations. If current assessment measures are indeed able to capture the level of extreme approach/impulsivity suggested by Gray's theory as being harmful to emotional and social functioning, then perhaps a larger and more temperamentally diverse sample might increase the power of finding such relationships.

Approach-Avoidance Temperament

The interaction of BIS and BAS also did not predict somatic complaints. In particular, children's reports of somatic complaints did not vary depending on different combinations of BIS and BAS (e,g., high BIS-low BAS). This is contrast to a body of emerging literature supportive of Corr's *joint subsystem hypothesis* and the differential effects of various combinations of BIS and BAS on overall well-being in adults and children (e.g., Coplan et al., 2006). It was hypothesized that children high in BIS and low in BAS (i.e., avoidant children) would experience the most problematic somatic complaints. The results indicate that the distinctions between levels of BIS and BAS may not be important. Avoidance temperament may have the strongest relation with somatic complaints.

This study illustrates that different combinations of levels of BIS and BAS are important to consider when it comes to emotions and social competence but are not as important when looking at health-related difficulties. Therefore, somatic complaints may be the outcome of a BIS-BAS predisposition toward emotions. In other words, having different levels of BIS and BAS may predispose children to experience some types of emotions or clusters of internalizing symptoms more intensely and more often which might lead to different amounts

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of somatic complaints. The emotions are likely more directly related to somatic complaints than the different combinations of BIS and BAS. The relationship, therefore, may be indirect. Using this conceptualization, BIS and BAS could be operating a few levels below somatic complaints. Future research will be needed to clarify these findings.

Parent and Child Concordance

In the current study it was predicted that all of the hypothesized associations would be found across all reporters and measures of temperament. Surprisingly, child-reported temperament, assessed via the BIS/BAS Scales child-report was the only significant predictor of temperament and internalizing problems. These findings are consistent with the literature and provide further support for the assertion that a high BIS is associated with internalizing problems in children. The moderate correlation between BIS and BAS and the finding that girls rated themselves higher on BIS is also consistent with the literature.

The subscales of the parent report of BIS/BAS and the SPSRQ were not significantly related to any index of internalizing problems or avoidance temperament. These results are confusing but make sense when the differences between reporters are considered. Parents were consistent raters of their child's temperament across the two parent-report measures but tended to disagree with their child's ratings of their own temperament. This was especially evident with respect to the avoidance measures. This may have influenced the results because children were the only reporters of emotions. Therefore, it makes sense that parent-reported temperament was not statistically related to child-reported emotional functioning. Interestingly, in previous studies where significant associations were found between approach-avoidance temperament and emotions, parents were raters of both temperament and emotional functioning (Colder & O'Connor, 2004; Blair, 2003, 2004). This highlights the importance of seeking children's perceptions of their own internal functioning, as failing to do so could result in Type II errors.

In addition, the functional domain being assessed is important to take into account when examining reliability and consistency across reporters. Across all measures of temperament, the alpha reliabilities of the avoidance scales were consistently lower than the approach scales. This indicates that parents and childrens ratings of avoidance temperament were not very similar, but their ratings of avoidance temperament were. As noted above, the parent-child concordance rate for avoidance temperament was low. This is consistent with past research demonstrating that children and parents often disagree when asked to report on internalizing problems (e.g., anxiety, depression, somatic symptoms; Grills & Ollendick, 2002, 2003; Klein, 1991; Rapee, Barrett, Dadds, & Evans, 1994). This is believed to be the case because parents do not have ready access to the inner feelings and thoughts of their children; they instead rely on observable behavior to make their inferences (Bird, Gould, & Staghezza, 1992). Children may be more accurate at reporting information related to internal states and should be used in this manner (Edelbrock et al., 1986). This evidence may explain why the concordance rate for approach temperament, which is more observable and thus more amenable to parent ratings, was higher than avoidance temperament in the current study. Furthermore, these results provide further support for the notion that parent and child ratings of behavior should not be arbitrarily combined, as they both offer unique, and somewhat differing perspectives on behaviour.

The final measure of approach-avoidance temperament, the point scoring reaction time task (PSRT), did not show the expected relations with parent-reported sensitivity to punishment or reward. Thus, the utility of this computer task as a behavioural measure of SP and SR was not supported in this study. Its relations with the emotion measures were not explored because of these preliminary null findings. The most problematic domain of the PSRT was sensitivity to reward, as children rated as high in SR did not show less slowing of reaction times from the pre-punishment block to the punishment. Children rated as highly sensitive to punishment tended to show greater slowing of reaction times in post-punishment red trials compared to non-red trials, but this difference

was not big enough to be significant and was only evident when SP ratings were examined (see *Figure* 6). Considering the cultural difference in parent-reported SP reported in the preliminary analyses, the current sample of children might have been more sensitive to punishment and less sensitive to reward. This is unlikely however, given that for every temperament measure the mean for the approach scale was greater than the avoidance scale. The inability of the PSRT to predict temperament, although disappointing, was not entirely unexpected. Colder and O'Connor (2004) reported results that were marginally significant and suggestive of a trend. In the current study, children may not have been motivated enough by the point-based reward system or may have found the task somewhat long and boring. Also, the use of a more stringent accuracy criterion may explain the incongruous findings. Unique sample characteristics may also have contributed (see below) here but it may also be that the PSRT is not a robust measure of the construct of BIS and BAS. Furthermore, the PSRT was administered in both group and individual formats. This may have influenced children's attention and motivation during the task. Clearly, further research is needed to clarify these results.

Unique Characteristics of the Current Study

Distribution of Somatic Complaints

It is important to note that in this study children reported a low frequency and intensity of somatic complaints compared to previous studies (Walker and colleagues, 2001; Garber et al., 1994). When somatic symptoms were counted using the criteria set out by Garber et al. (only counting symptoms is they were endorsed "a lot" or "a whole lot"), only 2.3% of children reported four or more symptoms. This is compared to the 15.2% reported in Garber et al. The validity of using such a conservative criterion has not been established in the literature, particularly with child populations. When our more liberal criterion was used to calculate frequencies, 63.3% of children reported four or more somatic complaints. These children had greater anxiety, depressive symptoms and

negative affect than children reporting three or fewer somatic symptoms. The sample size and variability of symptoms was greater in previous investigations, which may explain the comparatively low frequencies in this study. The CSI total score was also low in the current study (in comparison to the standardization sample), suggesting that the children in the study endorsed symptoms at a lower intensity than children in other studies. The sample for the current sample was unique in its ethnocultural and sociodemographic background. Therefore, the relevance of this finding within the context of these unique characteristics will be discussed in more detail below.

Ethnocultural Considerations

The results of this study should be interpreted within the context of the unique characteristics of the sample. Most studies that have examined the predictors and correlates of somatic complaints in children sampled North American/European populations. In the current study, the majority of participating children were first generation immigrants of Asian origin. Most families were also highly educated. This combination of demographic characteristics is important to consider because somatic behaviours occur within the larger systemic and cultural context. In fact, research suggests that the phenomenon of somatization in Asian populations may be different to European populations. In particular, some researchers have suggested that Asians are more likely, as a cultural group, to express psychological problems through somatic mechanisms (Chen, 1995; Hong, Lee & Lorenzo, 1995). The reasons offered for this are that (1) it is culturally unacceptable to express emotions in Asian culture because this interferes with social interaction; (2) the Asian lexicon is limited in its ability to explain psychological distress and so distress is expressed using physical terms; and (3) Asians have holistic beliefs about the mind and body and therefore do not see physical and psychological functioning as separate entities (see Mak & Zane, 2004 for a review). Unfortunately, the research confirming these differences has been largely inconclusive and poorly interpreted. Some studies report differences in reporting in clinical populations, but not in community samples (Kleinman,

1980; Mumford, 1993; Lin et al., 1992). Other studies suggest that rates differ depending on the type of health care setting patients choose to visit (Moore & Boehnlein, 1991). Research has now largely demonstrated that somatization is prevalent in all ethnocultural groups and that Asians are as likely as any other group to have somatic complaints (Kirmayer & Young, 1998). What may differ in Asian populations are the specific predictors of somatization. One study found that the strongest predictors of somatization in Asian Americans are anxiety and depressive disorders, female gender, old age and low education (Kirmayer & Young, 1998; Mak & Zane, 2004). These are important findings, but provide little insight into developmental considerations, especially at what point in development these predictors emerge, how they change, and if they are important in childhood as well. These characteristics are important to consider because the associations found in this study may have been elevated because of the increased proportion of Asian children and parents in the sample. Research has shown that anxiety and depression uniquely predict somatization in Asian adults, thus, the significant findings in this study may only generalizable to Asian populations.

Ethnocultural differences were evident only with respect to children's reporting of positive emotions and parents ratings of sensitivity to punishment. Children with Asian born parents rated themselves lower on positive affect and were rated higher in sensitivity to punishment by their parents. One possible explanation for this is that immigrant families may experience more life stressors and daily hassles than children of North American/European heritage. These stresses may influence their mood. With respect to sensitivity to punishment, shyness and inhibition are more socially accepted traits in Asian cultures and are related to positive peer relationships, emotional well-being, and social adjustment at school (Chen, Dong & Zhou, 1997; Chen, 2000; Chen et al., 1995). It is possible that in this study parents endorsed items related to shy and inhibited behaviour because it is more socially acceptable. However, this finding was not consistent across measures, as children did not rate themselves high on this trait nor were any differences found on the parent report of BIS and BAS. The

SPSRQ is purportedly a more accurate measure of SP, so it may be the case that it revealed a true ethnocultural difference whereas the other measures did not.

Limitations

The main limitation of this study was its cross-sectional design. More specifically, temperament, emotions and somatic complaints were all measured concurrently and this restricted any causal interpretations of the study findings. A longitudinal design with a multi-method measurement of temperament would be able to better investigate this phenomenon in children. The results of this study suggest that it in such a study it would be important to include both parent and child reports of temperament and internalizing problems, as well as measures that eliminate perceptual biases and errors associated with linguistic complexity. This might include electrodermal skin response, vagal tone, cortisol assays, EEG and behavioural tasks like the PSRT. To establish causality these measurements, as well as measures of somatic complaints, would need to be taken early in childhood and measured at various times throughout development. The time-order of temperament leading to negative emotions which then lead to somatic complaints would have to be demonstrated in some way. As a starting point, this study highlights the importance of carrying out such investigations – not only to understand how temperament contributes to somatic complaints, but also to gain insight into the mechanisms and processes underlying the relationship between negative emotions and somatic complaints.

Another limitation is that current self-report measures of approach and avoidance temperament may not have adequately captured the constructs of interest in the current study. In fact, the measurement of these temperamental constructs is a problem that has been recently noted in the literature (Cogswell, Alloy, van Dulmen, 2006). There are various measures available but very few are good measures of all the constructs underlying avoidance and approach temperament. They all purportedly measure Gray's BIS and BAS constructs, but some measure specific aspects of approach and avoidance (e.g., SPSRQ and

PSRT measure sensitivity to punishment and reward) while others look at more broad facets (e.g., items on BIS/BAS Scales have a striking similarity to measures of social anxiety and extraversion). It is possible that these instruments are poor measures of approach and avoidance temperament or the domains that they measure represent only one facet of approach and avoidance. Additional research into the psychometric properties and how these measures map onto the hierarchical structure of approach and avoidance are needed (see Nigg, 2006). It was hoped that the inclusion of the PSRT as a behavioural measure of approach and avoidance would mitigate some of the limitations of self-report instruments. Unfortunately, the validity of this task was not supported.

A related issue is the restricted range of levels of approach and avoidance temperament reported by parents and children. The upper and lower limits of both avoidance and approach were not reached, which may have reduced the associations between variables or made it difficult for other associations to emerge. For instance, a greater distribution of avoidance scores might have increased the validity of the PSRT, especially since punishment difference scores were in the predicted direction but were not large enough. Colder and O'Connor (2004) did not provide means and standard deviations for the SPSRQ measures in their sample so a direct comparison with our obtained means and standard deviations is not possible. The restricted range problem may also be due to a neutral response bias of both Asian children and parents. Some studies have found that Asian-Americans tend to rate themselves more neutrally on self-reports of internalizing difficulties compared to North American/Europeans (e.g., Carmody, 2005). This might be due to differences in cultural attitudes towards individualism and collectivism.

Measurement error, possibly due to modality effects, may have had an impact on the results as well. In particular, parent-reports were administered orally via telephone and this may have had an effect on their responses regarding their child's temperament. Previous studies have not used this type of administration and so it is possible that it influences the types of responses parents make and ultimately modifies the factor structure of the instrument(s).

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For instance, parents may have responded more neutrally to items to avoid a perceived social judgement by the interviewer. Many studies examining differences between administration modalities have demonstrated that social desirability bias is greater when telephone surveys and in-person interviews are used (e.g., Dillman, 1991; Pruchno & Hayden, 2000; Schwartz et al., 1991). This also might help explain the restriction of range problem discussed above. Also, some parents may have had difficulty providing likert-type answers to questions that they could not see visually. Future research could address administration modality effects in relation to ratings of temperament, particularly approach and avoidance.

Lastly, a more diverse sample would have allowed for more informative ehtnocultural comparisons and helped explicate possible effects due to socioeconomic status. The current sample of children tended to come from educated immigrant families therefore interpretations about the results can only be extended to this specific sector of the population. As well, all Asian ethnocultural groups were lumped together to minimize the effects of low sample size. It is possible that there are differences within these Asian groups that were not captured in this study. Future studies should keep this in mind when planning their sample as this will affect the communities and institutions that will be utilized for data collection.

Directions for Future Research

The gender differences discovered in this study demonstrate a need for further investigation. In particular, the differential relation of avoidance and internalizing problems with somatic complaints warrants replication and examination. The processes that underlie these differences may be important to consider, as would the possible contributions of culture and socialization discussed earlier. Also, children's perceptions of anxiety and negative emotions, how they are regulated, and the cultural beliefs guiding these perceptions would shed some light on this very complex and intriguing phenomena.

Another area recommended for future research is emotion regulation and coping. The level of specific emotions that are experienced are certainly important with respect to somatic complaints, but what we do with those emotions might be just as important. Avoidance and approach temperament may be differentially associated with emotion regulation ability, which may then have an impact on somatizing behaviour in children. Gross (1998) defines emotion regulation as how individuals control what emotions they have, when they have them, and how they experience or express them. These processes can be automatic, controlled, conscious or unconscious and involve various processes and circuits in the brain. The study of regulatory abilities may shed some light on how temperament and environment interact to produce individual differences in somatic complaints.

In fact, the findings of a recent study suggest that self-regulation varies depending on levels of BIS and BAS. Bjørnebekk (2007) found that children with high BIS sensitivity engaged in less effective self-regulatory strategies compared to children high in BAS in a problem-solving situation. High BIS children showed more difficulties taking action, initiating problem-solving approach behaviour, and tended to focus more on avoiding conflict with others. This suggests that poor regulatory ability is associated with BIS activity and provides some speculatory insight into why avoidance may be associated with somatic complaints. Someone high in BIS may also be more likely than someone low in BIS to have poor regulatory abilities, which may then lead to expression of conflict, distress and negative emotions through somatic mechanisms. This is not to say that a high BIS will determine regulatory abilities; it is probably just more likely. The contribution of parental socialization and peer groups in regulatory processes would be important to study as well because these factors may help shape and condition children's temperamental predispositions to respond to their environment. These are both important contributors to the development of emotional well-being and social competence (Rothbart, Ellis & Posner, 2004) and therefore should be included in future investigations.

In summary, subsequent investigations of the association between temperament, emotions and somatic complaints should aim to examine this phenomenon longitudinally and be cognizant of potential gender differences and the limitations of current assessment instruments for assessing approach and avoidance temperament. Cultural perspectives on illness and emotion and culture-specific predictors of somatic complaints will also be important to consider.

Practical Implications

The results of this study have implications for the assessment and treatment of somatic complaints and internalizing problems in children. For assessment, the current study highlights the importance of considering avoidance temperament, internalizing problems and gender as part of a comprehensive pediatric and/or psychosocial assessment. Children who are avoidant may be more likely to have somatic complaints, therefore, children who present with a predominantly inhibitory temperament or personality may need to have somatic complaints evaluated along with other important domains of functioning. Additionally, if a child presents primarily with somatic concerns, it may be necessary to assess possible internalizing problems and treat those difficulties first. Identifying the degree to which a child's temperamental style fits with their parents parenting style would be helpful for understanding the development of the problem and how you might intervene with the child, parent and family. Matching treatments with a child's personality would be important, and for children with somatic complaints it may be more appropriate for them to be involved in cognitive-behavioral-based therapies that help them understand how their thoughts and feelings affect their behaviour, or treatments specifically targeted at helping children deal with anxiety and negative emotions.

APPENDICES

Appendix A

Children's Somatization Inventory-18 (CSI-18—Child Report)

Below is a list of symptoms that children and teenagers sometimes have. Circle a number telling how much you were bothered by each symptom during the past two weeks.

In the last 2 weeks, how much were you bothered by each symptom?

		Not at all	A little	Some	A lot	A whole lot
1.	Headaches	0	1	2	3	4
2.	Faintness or dizziness (feeling faint or dizzy)	0	1	2	3	4
3.	Pain in your heart or chest	0	1	2	3	4
4.	Feeling low in energy or slowed down	0	1	2	3	4
5.	Pains in your lower back	0	1	2	3	4
6.	Trouble getting your breath (when you're not exercising)	0	1	2	3	4
7.	Numbness or tingling in parts of your body	0	1	2	3	4
8.	Weakness (feeling weak) in parts of your body	0	1	2	3	4
9.	Nausea or upset stomach (feeling like you might throw up, or having an upset stomach)	0	1	2	3	4
10.	Constipation (when it's hard to have a BM or go poop)	0	1	2	3	4
11.	Loose (runny) BMs or diarrhea	0	1	2	3	4
12.	Pain in your stomach or abdomen (stomach aches)	0	1	2	3	4
13.	Your heart beating too fast (even when you're not exercising)	0	1	2	3	4
14.	Difficulty swallowing	0	1	2	3	4
15.	Feeling bloated or gassy	0	1	2	3	4
16.	Food making you sick	0	1	2	3	4
17.	Pain in your knees, elbows or other joints	0	1	2	3	4
18.	Pain in your arms or legs	0	1	2	3	4
19.	**Girls Only**: In the last two weeks, have you had your period?		YES		NO	

Appendix B

<u>Children's Depression Inventory – Short Form</u>

Describe how you have been in the past two weeks....

Item 1
☐ I am sad once in a while
☐ I am sad many times
loves me.
☐ I am sad all the time
loves me.

Item 2
☐ Nothing will ever work out for me
☐ I am not sure if things will work out for me.
☐ Things will work out for me O.K.

Item 3
☐ I do most things O.K.
☐ I do many things wrong.
☐ I do everything wrong

Item 4
☐ I hate myself.
☐ I do not like myself.
☐ I like myself.

Item 5
☐ I feel like crying everyday
☐ I feel like crying many days
☐ I feel like crying once in a while

Item 6
☐ Things bother me all the time
☐ Things bother me many times
☐ Things bother me once in a while

Item 7
☐ I look O.K.
☐ There are some bad things about my looks
☐ I look ugly.

Item 8
☐ I do not feel alone
☐ I feel alone many times
☐ I feel alone all the time

Item 9
☐ I have plenty of friends
☐ I have some friends but I wish I had more.
☐ I do not have any friends.

Item 10
☐ Nobody really loves me.
☐ I am not sure if anybody
☐ I am sure that somebody

Appendix C

Multidimensional Anxiety Scale for Children -10

This questionnaire asks you how you have been thinking, feeling, or acting recently. For each item, please circle the number that shows how often the statement is true for you.

If a sentence is true about you a lot of the time, circle 3.

If it is true about you some of the time, circle 2.

If it is true about you once in a while, circle 1.

If a sentence is not ever true about you, circle 0.

Remember, there are no right or wrong answers, just answer how you have been feeling recently.

1. The idea of going away to camp scares me	0	1	2	3
2. I'm afraid that other kids will make fun of me	0	1	2	3
3. I try to stay near my mom or dad	0	1	2	3
4. I get dizzy or faint feelings	0	1	2	3
5. I feel restless and on edge	0	1	2	3
6. I feel sick to my stomach	0	1	2	3
7. I get nervous if I have to perform in public	0	1	2	3
8. Bad weather, the dark, heights, animals, or bugs scare me	0	1	2	3
9. I check to make sure things are safe	0	1	2	3
10. I feel shy	0	1	2	3

Appendix D

<u>Feelings and Emotions (PANAS- C)</u>

This scale consists of a number of words that describe different feelings and emotions. Read each item and then circle the appropriate answer next to that word. Indicate to what extent you have felt this way during the past few weeks.

Feeling or emotion	Very slightly or not at all	A little	Moderately	Quite a bit	Extremely
Interested	1	2	3	4	5
Sad	1	2	3	4	5
Frightened	1	2	3	4	5
Alert	1	2	3	4	5
Excited	1	2	3	4	5
Ashamed	1	2	3	4	5
Upset	1	2	3	4	5
Happy	1	2	3	4	5
Strong	1	2	3	4	5
Nervous	1	2	3	4	5
Guilty	1	2	3	4	5
Energetic	1	2	3	4	5
Scared	1	2	3	4	5
Calm	1	2	3	4	5
Miserable	1	2	3	4	5
Jittery	1	2	3	4	5
Cheerful	1	2	3	4	5
Active	1	2	3	4	5
Proud	1	2	3	4	5
Afraid	1	2	3	4	5
Joyful	1	2	3	4	5

Lonely	1	2	3	4	5
Mad	1	2	3	4	5
Fearless	1	2	3	4	5
Disgusted	1	2	3	4	5
Delighted	1	2	3	4	5
Blue	1	2	3	4	5
Daring	1	2	3	4	5
Lively	1	2	3	4	5

Appendix E

Read each statement below and write next to the item how true it is of you using the following scale .

0	1	2	3
not true	somewhat true	true	very true

1. ____I usually get very tense when I think something unpleasant is going to happen

2. ____ I feel excited and full of energy when I get something that I want

3. ____ When I want something, I usually go all the way to get it

4.____ I often do things for no other reason than that they might be fun

5. ____ I worry about making mistakes

6. ____ When I am doing well at something, I like to keep doing this

7. ____ I do everything to get the things that I want

8. ____ I crave for excitement and new sensations

9. ____ I am hurt when people are angry with me or tell me that I do something wrong

10. ____ I get thrilled when good things happen to me

11. ____When I see an opportunity to get something that I want, I go for it right away

12. ____ I am always willing to try something new, when I think it will be fun

13. ____ I feel pretty upset when I think that someone is angry with me

14. ____ I do not become fearful or nervous, even when something bad happens to me

15. ____ I get very excited when I would win a contest

16. ____Nobody can stop me when I want something

17. ____ I often decide to do things really quickly

18. ____ I feel worried when I think I have done poorly at something

19. ____I get really excited when I see an opportunity to get something I like

20. ____I am very fearful compared to my friends

Appendix F

<u>BIS/BAS Scales – parent report</u>

Parents: Please indicate using the scale below how true/untrue these statements are of your child.

1	2	3	4	5	6	7
Extremely untrue	quite untrue	slightly untrue	neither true nor untrue	slightly true	quite true	extremely true

If my child thinks something unpleasant is going to happen he/she usually gets pretty worked up.

1   2   3   4   5   6   7

When good things happen to my child, it affects him/her strongly.

1   2   3   4   5   6   7

When my child sees an opportunity for something, he/she gets excited right away.

1   2   3   4   5   6   7

Even if something bad is about to happen, my child rarely seems to be nervous or fearful.

1   2   3   4   5   6   7

My child worries if he/she thinks that he/she has done poorly at something.

1   2   3   4   5   6   7

My child has few fears compared to his/her friends.

1   2   3   4   5   6   7

When my child wants something, he/she goes all out to get it.

1   2   3   4   5   6   7

My child feels pretty worried or upset when he/she thinks or knows that somebody is angry at him/her.

1   2   3   4   5   6   7

When my child gets something that he/she wants, he/she feels energized.

1   2   3   4   5   6   7

My child acts on the spur of the moment.

1   2   3   4   5   6   7

When my child is doing well at something, he/she loves to keep at it.

1   2   3   4   5   6   7

It would excite my child very much to win a prize.

1   2   3   4   5   6   7

Criticism or scolding hurts my child quite a lot.

1   2   3   4   5   6   7

When my child wants something, he/she rarely takes no for an answer.

1   2   3   4   5   6   7

My child will often do things for no reason other than that they might be fun.

1   2   3   4   5   6   7

My child worries a lot about making mistakes.

1   2   3   4   5   6   7

My child craves excitement and new sensations.

1   2   3   4   5   6   7

My child is always willing to try something new if he/she thinks it will be fun.

1   2   3   4   5   6   7

My child goes out of his/her way to get something he/she wants.

1   2   3   4   5   6   7

When my child sees something he/she wants, he/she moves on it right away.

1   2   3   4   5   6   7

Appendix G

<u>Sensitivity to Punishment and Sensitivity to Reward Questionnaire (SPSRQ) - parent report</u>

Please indicate below the degree to which you agree that the statements below describe your child.

1	**2**	**3**	**4**	**5**
Strongly disagree	Slightly disagree	Agree	Slightly agree	Strongly agree

1. The good prospect of obtaining a reward motivates your child strongly to do some things.
      1   2   3   4   5

2. Your child prefers not to ask for something when they are not sure they will obtain it.
      1   2   3   4   5

3. Your child often does things to be praised.
      1   2   3   4   5

4. Your child is often afraid of new or unexpected situations.
      1   2   3   4   5

5. Your child enjoys being the center of attention.
      1   2   3   4   5

6. Your child is a shy person.
      1   2   3   4   5

7. When your child is in a group, they try to stand out as the smartest or the funniest.
      1   2   3   4   5

8. Whenever possible, your child avoids demonstrating their skills for fear of being embarrassed.
      1   2   3   4   5

9. When your child gets something they want, they feel excited and energized.
      1   2   3   4   5

10. When in a group, your child has difficulty thinking of something to say.
      1   2   3   4   5

11. Your child does a lot of things for approval.
      1   2   3   4   5

12. Whenever they can, your child avoids going to unfamiliar places.
      1   2   3   4   5

13. The possibility of obtaining social status moves your child to action, even if this involves not playing fair.
      1   2   3   4   5

14. Your child often worries about things they said or did.
         1   2   3   4   5

15. Your child generally prefers activities that involve immediate reward.
         1   2   3   4   5

16. It is difficult for your child to talk with someone they do not know.
         1   2   3   4   5

17. Your child often has trouble resisting the temptation of doing forbidden things.
         1   2   3   4   5

18. Your child generally tries to avoid speaking in groups.
         1   2   3   4   5

19. Your child likes to compete and do everything they can to win.
         1   2   3   4   5

20. Your child could do more things if it were not for their fear.
         1   2   3   4   5

21. Your child has a lot of difficulty ending a fun activity.
         1   2   3   4   5

22. Your child is afraid of many things compared to other children their age.
         1   2   3   4   5

23. Your child sometimes does things for quick reward.
         1   2   3   4   5

24. Your child often refrains from doing something he/she likes in order not to be rejected or disapproved of by others.
         1   2   3   4   5

25. Your child has difficulty staying focused on his/her school work in the presence of an attractive alternative.
         1   2   3   4   5

26. Your child often refrains from doing something because of fear of being embarrassed.
         1   2   3   4   5

27. Your child engages in risky behavior to obtain a reward.
         1   2   3   4   5

28. If your child thinks that something unpleasant is going to happen, they get pretty worked up.
         1   2   3   4   5

29. Your child likes competitive activities.
         1   2   3   4   5

30. Criticism or scolding hurts your child very much.
         1   2   3   4   5

31. Your child would like to be a socially powerful person.
         1   2   3   4   5

32. Your child likes displaying their physical abilities even though it may involve danger.

      1   2   3   4   5

33. Your child craves excitement and new sensations.

      1   2   3   4   5

Appendix H

<u>Telephone Health Screening Questions</u>

1. What type of complaints did/does your child have? Please list.

   _____
   _____
   _____
   _____

2. Does your child have any current short and/or long-term health problems that have been diagnosed by a physician or specialist? Please list.

   _____
   _____
   _____
   _____

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