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Relations of Temperament Dimensions to Young Children's Strategy Use in a Novel Situation

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ABSTRACT

Temperament can be defined as individual predispositions to reactivity and regulation (Rothbart et al., 2004). Inherent in this conceptualization of temperament is the role of self-regulation, defined as the engagement of cognitive resources to alter a prepotent response, an aspect of temperament (Cole et al., 2019; Kopp, 1982; Rothbart et al., 2004). The present study hypothesizes that different dimensions of temperament—Negative Affectivity, Effortful Control, and Extraversion/Surgency—are related to the extent to which children respond fearfully and engage cognitive resources in a novel, fear-inducing context (Rothbart et al., 2004). Participants included 149 children between the ages of 30 and 60 months and their mothers. Mothers completed the Child Behavior Questionnaire as a measure of temperament dimensions. Children completed the Novel Boxes procedure, in which they were introduced to an unfamiliar research assistant (Segment 1) and asked to engage with a series of three novel, scary boxes (Segments 2-4). Two teams of behavioral coders rated children's emotions, including fear, and the extent to which children engaged cognitive resources, as observed from their behavior from video records. As predicted, children who were rated as higher in Extraversion/Surgency were less fearful and engaged cognitive resources more frequently and to a greater extent. Contrary to hypotheses, higher Negative Affectivity was inversely related to children's fear intensity and not related to their cognitive engagement, and higher Effortful Control was not related to higher cognitive engagement. The findings are discussed in relation to published evidence as well as in terms of future research directions.

TABLE OF CONTENTS

LIST OF TABLES

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Chapter 1

Introduction

Self-Regulation

Self-regulation can be broadly defined as an individual's ability to modulate their behaviors, thoughts, emotions, and reactions in response to external stimuli and internal states (Kopp, 1982; Vohs & Baumeister, 2004). While self-regulation may be employed to comply with social standards or the orders of an authority figure, it is necessarily initiated by the actor (Kopp, 1982). Among children, self-regulation plays an important role in the ability to initiate socially appropriate behaviors with peers, follow the instructions of an authority figure, and set and complete goals (Eisenberg et al., 2010; Trommsdorff & Cole, 2011). Each of these skills contributes to children's ability to succeed in school, both with respect to academic achievement and the maintenance of healthy social relationships (Eisenberg et al., 2010; Harrington et al., 2020). Later in life, self-regulation influences an individual's ability to maintain a balanced lifestyle, resist overindulgence in temptations ranging from leisure time to snacking, and achieve long-term goals such as pursuing a specific career path (Vohs & Baumeister, 2004). Furthermore, deficits in children's self-regulation skills are linked to such serious outcomes in their adulthood as financial strain, poor physical health, and criminality (Moffitt et al., 2011). In sum, the role that self-regulation plays in an individual's functioning throughout life and across a variety of domains provides support for the importance of research on this subject.

The ability to modulate responses to external stimuli and internal states involves the employment of strategies; effective strategies that conform to social standards play an important role in determining such potential outcomes of self-regulation (Grolnick et al., 1996; Kopp,

1982; Vohs & Baumeister, 2004). Generally, the strategies that children use are not organized into a clear organizational structure. An exception is a framework that categorizes strategies, as employed by young children confronted with a stranger, into a continuum of strategies defined by how children direct their attention (Grolnick et al., 1996). At one end are strategies that redirect attention away from the emotionally salient stimulus (e.g., avoiding eye contact with a stranger by playing with toys to regulate discomfort). At the other end are strategies that involve attending to the salient stimulus (e.g., looking at the stranger without speaking), which are associated with discomfort. As an intermediate on this continuum are strategies designed to pacify the actor (e.g., seeking physical proximity to a familiar experimenter, fidgeting), which do not tend to be associated with discomfort (Grolnick et al., 1996). In sum, the ability to shift attention away from the evocative stimulus is associated with less emotional discomfort and is therefore regarded as the better strategy for this situation. Despite the conceptualization of children's strategies on this attentional continuum, the study analyzed each point on the continuum as a separate category (Grolnick et al., 1996). This conceptualization of regulatory behaviors as distinct categories on a continuum is relevant to the method of the present study. However, it is important to note that attention, a main focus of the study conducted by Grolnick et al., (1996), is only one of several cognitive resources (e.g., memory, problem-solving) analyzed in the strategies children employ in the present study (Cole et al., 2019). In the present study, the coding scheme used by behavioral coders to rate children's cognitive engagement consists of five categories of self-regulation strategies placed on a continuum, with higher scores indicating higher levels of cognitive engagement.

Consistent with both cognitive and developmental models of self-regulation, one recent framework underscores the common view that putative regulatory strategies vary in the extent to

which they recruit cognitive resources to modulate prepotent responses (Cole et al., 2019). Prepotent responses are highly probable, relatively spontaneous or automatic reactions to a situation or stimulus, such as a young child's anxiety or avoidance of a stranger who arrives and tries to engage the child (Cole et al., 2019). In this framework, strategies that engage cognitive resources, such as language, problem-solving, and attention, should support regulation of fear and avoidance. For example, if the young child puts their head down on the table and does not interact with the individual, which is regarded as self-soothing, they have not engaged cognitive resources that help them modulate the fear/avoidance (Cole et al., 2019). Through this model, the list of strategies usually used by children in this type of situation can be organized and rated based on the extent to which any strategy engages a specific cognitive resource, and how that relates to both the prepotent emotions displayed and the approach behaviors that imply overcoming avoidance (Cole et al., 2019).

This approach is consistent with the developmental framework proposed by Kopp (1982), which emphasizes the emergence of various types and levels of cognitive resources over the course of early childhood that are crucial to a child's capacity for self-regulation. As outlined by Kopp (1982), self-regulation emerges around the third year of life, at which point a number of cognitive resources mature to the point of being available for children to recruit as they deal with an emotionally challenging situation. In the first year, children are very limited in their own ability to regulate their reactions, but they have some involuntary behaviors that prevent over-stimulation. Then with learning through socialization and the emergence of initial cognitive skills (e.g., expressive language), they can alter their behavior (e.g., comply with instructions to clean up toys even if they do not want to). However, this stage of regulation is a response to adult instruction and may not occur if the adult is not present (Kopp, 1982). True self-regulation,

according to Kopp, requires cognitive involvement, such as memory, self-awareness, planning, or means-ends thinking (understanding the consequences of specific actions), that enable children to regulate their own prepotent responses even without instruction or monitoring (Kopp, 1982).

A developmental framework lays out a conceptual basis for how children change with age, in this case, how they come to self-regulate through the engagement of developing cognitive resources (Kopp, 1982). However, children vary widely in when they achieve developmental advances. One source of these variations is temperament. The purpose of the present study is to investigate the relation between children's temperament dimensions and the extent to which their self-regulation strategies recruit cognitive resources. Although temperament has been studied in relation to young children's observed behavior in an emotionally challenging laboratory task (e.g., Calkins et al., 1996; Stifter et al., 2008), no study has related temperament to the concept of children's engagement of cognitive resources.

Temperament

Temperament is defined as innate predispositions that influence an individual's display of emotions, propensity towards action or restraint, and behavioral tendencies across social contexts (Goldsmith et al., 1987; Shiner et al., 2012). In an influential intersection of prominent theories, temperament researchers met with the goal of forming a more unified picture of conceptualizing this important individual difference (Goldsmith et al., 1987). They compared their approaches in an attempt to find a more unifying framework for temperament research. Among the theorists present were Chess and Thomas, Buss and Plomin, Goldsmith, and Rothbart (Goldsmith et al., 1987).

Although the models of temperament presented in the roundtable are distinct in their core attributes, they reach a consensus on several important points. First, each group of theorists agrees that emotionality is an essential aspect of temperament, although there is some disagreement regarding which displays of emotion are dictated by temperament. Relevant to the present study, each of the four models of temperament presented in the roundtable conceptualize fear, or its constituent components, as temperamentally based (Goldsmith et al., 1987). Second, across these theories, temperament is considered a foundational component of personality, and is present from early life (Goldsmith et al., 1987; Rothbart et al., 2004). For this reason, early childhood lends itself particularly well to research on temperament, as its expression is less influenced by external factors and more purely represents innate qualities at younger ages (Goldsmith et al., 1987). Third, temperament is viewed as being stable throughout life and across situations. Therefore, situational changes in the expression of temperament should not be confused with fluctuations in its profile, but rather seen as the result of dynamic interactions between temperament and environment (Goldsmith et al., 1987).

Of these different models, child temperament research relies most on Rothbart's model of temperament (e.g., Rothbart et al., 2004). Rothbart and her collaborators have conducted the most extensive research on temperament and development across the lifespan, and most studies of children's temperament use that conceptual framework and the measures developed by the Rothbart team (e.g., Rothbart, 2007; Rothbart et al., 2001; Rothbart et al., 2004). In this model, temperament is defined as individual predispositions to reactivity and regulation that influence emotionality, activity, and attention, and which are shaped by biological, genetic, and environmental interactions and factors (Goldsmith et al., 1987; Rothbart et al., 2004). Reactivity is defined as the latency and strength of an individual's behavioral, physiological, or emotional

response to a stimulus (Rothbart et al., 2004; Rothbart & Posner, 2005). Regulation is conceptualized as behaviors that influence an individual's reactivity (Rothbart et al., 2004; Rothbart & Posner, 2005). This model then is consistent with the view that self-regulation entails the effect of the effortful employment of cognitive resources on an individual's prepotent response (i.e., context-based reflexive reaction) to a situation (Cole et al., 2019).

Within this model, the reactive aspect of temperament refers to the strength and extent to which an individual responds to stimuli and comprises two temperament dimensions: negative affectivity (i.e., negative emotionality) and extraversion/surgency (i.e., positive emotionality) (Rothbart et al., 2004). Negative affectivity is defined as an individual's propensity to react adversely to, and withdraw from, novel situations. Among children between the ages of 3-7 years, negative affectivity encompasses negative emotionality (e.g., fear, anger, sadness), low approach, and low soothability (Rothbart et al., 2001; Rothbart et al., 2004). Extraversion/surgency represents a willingness to seek out and approach new situations with enthusiasm and respond favorably. This dimension constitutes positive emotionality (e.g., smiling, laughing), high approach, high energy, elevated tolerance for high-intensity stimuli, and impulsivity (Rothbart et al., 2001; Rothbart et al., 2004).

The regulatory dimension of temperament is referred to as effortful control, which represents an individual's willful modulation of their reactions to stimuli (Rothbart et al., 2004). This dimension includes inhibitory control, low tolerance for high-intensity stimuli, and heightened attentional capacities (Rothbart et al., 2001). Here, inhibitory control is an individual's ability to suppress or alter a prepotent reaction for the purpose of engaging in context-appropriate responses (Rothbart, 2007; Rothbart et al., 2004).

Relations Among Self-Regulation and Dimensions of Temperament

According to the models presented by Kopp (1982), self-regulation emerges during early childhood due, in part, to the development of cognitive resources that influence the extent to which a child is able to employ effective strategies to modulate their own prepotent behaviors and emotions. As proposed by Rothbart (e.g., Rothbart et al., 2004), regulation is a core component of temperament. Inherent in these definitions is the concept that temperament contributes to individual differences in self-regulation. An extension of that premise is that temperamental variations predict individual differences both in emotional reactivity in emotionally evocative situations and in the extent to which effective strategies are engaged (Rothbart et al., 2004). Linking this to models of self-regulation, individual differences in temperament should predict the extent to which children engage cognitive resources in their strategy use (Kopp, 1982; Rothbart et al., 2004).

There are several gaps in our knowledge on this topic. Much of the evidence on the relation between self-regulation and temperament examines their association among at-risk populations, such as children exhibiting behavioral problems and other psychological symptoms; findings are often mixed. In comparison, relatively few studies focus specifically on the relation between dimensions of temperament and self-regulatory strategy use. Studies that investigate relations between temperament and strategy use typically address emotion regulation, and do not capture the full scope of thoughts and behaviors that form strategies for self-regulation. Another limitation of the available evidence is that many studies measure each construct with the same method, introducing shared method bias. Specifically, they assess parent reports of both children's temperament and self-regulation or emotion regulation to test associations between these two constructs. Although the constructs are distinct, and the instruments attempt to validly

distinguish them, parents may not make those same distinctions and simply describe their children, introducing a method bias. Nonetheless, the evidence supports predictions about the associations between temperament dimensions, prepotent emotions, and the extent to which children draw on their cognitive resources in their strategies for regulating their emotions.

A key feature of the present study is the examination of the relation between children's temperament dimensions and strategy use specifically in the context of fear. In this task, children interact with a research assistant unfamiliar to them (i.e., the "stranger"), who is dressed in dark clothing, displays a flat affect, and does not answer the children's questions as to their identity. The stranger informs the child that they must retrieve three keys in order to earn a prize. Each key is hidden in a large storage box decorated with animal patterns, an opening lined with foam teeth, and fitted with a speaker that plays a different animal sound each time the stranger enters the room with a new box. Therefore, the predictions made with respect to temperament and strategy use are made with the assumption that fear is elicited amongst the children who participated in this task.

Negative Affectivity

Negative affectivity encompasses an individual's tendency to react with heightened distress to novel stimuli. A core component of this dimension is therefore a disposition towards displaying more frequent and more intense fear, anger, and sadness, such as in the context of perceived threat (Rothbart, 2007; Rothbart et al., 2004). In accordance with these characteristics, heightened negative affectivity is associated with an attentional bias towards threatening stimuli. For example, children who score higher on measures of negative affectivity than other children are more likely to attend to negative than neutral words in a target detection procedure (Lonigan

& Vasey, 2009). These findings highlight the fact that negative affectivity predisposes individuals to attend to aversive stimuli, thereby increasing the likelihood that they will experience negative emotions in response (Lonigan & Vasey, 2009).

As a result of the preparedness to react with negative emotion, it follows that children who are higher in negative affectivity are more inhibited and less likely to approach novel stimuli (Rothbart et al., 2004). As discussed by Derryberry and Rothbart (1997), excessive fear prevents individuals from approaching and engaging with novel stimuli in their environment. For young children, there is supportive evidence. When presented with a stranger and novel toys, toddlers rated high in negative affectivity, and who display heightened fear in social situations as infants, are less likely to approach novel stimuli (Calkins et al., 1996). Related to such inhibition, negative affectivity is also linked to internalizing behavior problems. Children who score higher on negative affectivity are also likely to be scored higher on internalizing behaviors, such as disengagement and avoidance of novel stimuli (Behrendt et al., 2020).

To regulate this predisposition and overcome tendencies toward inhibited and avoidant behaviors, children need to engage their higher order cognitive resources in the form of strategy use (Cole et al., 2019). However, evidence suggests that young children who are higher in negative affectivity tend to focus on fear-inducing stimuli, rather than use executive attention to distract themselves or engage with the stimuli (Grolnick et al., 1996; Lonigan & Vasey, 2009). Without engaging with the task or exploring the novel environment, children are unlikely to benefit from novel experiences. Children rated higher on negative affectivity and lower on all other temperament dimensions (i.e., extraversion/surgency, effortful control) are more likely than those with heightened extraversion/surgency and effortful control to engage in ineffective emotion regulation strategies (Van Beveren et al., 2020). Similarly, children with greater levels

of negative affectivity are more likely to engage in stimulus-bound emotion regulation strategies (Santucci et al., 2008), which are linked to heightened emotional dysregulation (Grolnick et al., 1996). In contrast to more cognitively-based strategies that involve redirection from distressing stimuli, and thus an opportunity to diminish emotional stress, stimulus-bound strategies involve heightened attention to distressing stimuli (Grolnick et al., 1996). In sum, preschool age children who are rated by their parents as higher in negative affectivity should engage in more prepotent negative emotion, e.g., fear, and avoidance of a novel person and task, and use less engagement of cognitive resources in their regulatory strategies (Calkins et al., 1996; Grolnick et al., 1996; Lonigan & Vasey, 2009; Rothbart et al., 2004; Santucci et al., 2008).

Extraversion/Surgency

The dimension of extraversion/surgency describes a disposition to be active, sociable, enthusiastic, and emotionally positive, and is linked to uninhibited approach to novel situations, including a propensity to seek out and engage with them (Rothbart, 2007; Rothbart et al., 2004). Evidence shows that toddlers, faced with a stranger and novel toys, and who are rated as higher on extraversion/surgency, are more likely to explore their surroundings in an uninhibited manner and to display little fear (Calkins et al., 1996). Although this is generally a positive attribute, higher levels of extraversion/surgency are also linked to externalizing behavioral patterns, like impulsiveness (Behrendt et al., 2020; Stifter et al., 2008). Apart from that potential risk, toddlers who are rated higher in extraversion/surgency are more exploratory, curious, and sociable in novel situations (Stifter et al., 2008).

Therefore, in a fear-inducing task involving a novel person and activity, preschool age children rated higher in extraversion/surgency by a parent should engage in more approach to the

novel situation and exhibit more positive emotion and approach to novelty than preschool age children rated lower in extraversion/surgency (Calkins et al., 1996; Rothbart et al., 2004; Stifter et al., 2008). A willingness to approach novel situations with enthusiasm and without inhibition is likely to increase the chance that children interact with novel situations. Moreover, their higher level of activity and approach may allow for more observation of strategic behaviors. When faced with an anger-inducing task, children rated higher on extraversion/surgency maintain greater focus on completing the task than children with higher negative affectivity (Dollar, 2008). Moreover, children rated higher in extraversion/surgency, but lower on effortful control and negative affectivity, show an increased likelihood of engaging in effective emotion regulation strategies (Van Beveren et al., 2020). This latter study points out the importance of effortful control, the regulatory dimension of temperament, for modulating dispositions toward negative affectivity or extraversion/surgency.

Effortful Control

Effortful control is the regulatory dimension of temperament and is defined by attentional control, inhibitory control, and tolerance for low-stimulus activities (Rothbart, 2007; Rothbart et al., 2004). From a temperament framework, effortful control is essential for self-regulation (Rothbart et al., 2004). As highlighted by Bridgett et al. (2013), the temperament dimension of effortful control and the cognitive domain of executive functioning, a set of skills—working memory, inhibitory control, and mental flexibility indexed as set-shifting—that enable executive control of psychological processes, inherently overlap. According to the conceptualization of self-regulation as a dynamic process, executive control processes, of which executive functioning skills are a component, can alter prepotent responses (Cole et al., 2019). In this view,

the employment of more sophisticated cognitive control processes should correlate with higher scores for self-regulation strategy use. It follows, then, that children who possess more robust features of effortful control are more likely to engage cognitive resources to a higher degree in their strategies than children who are rated lower in effortful control (Bridgett et al., 2013; Cole et al., 2019; Rothbart et al., 2004).

The executive attention network is the underlying cognitive mechanism that the working temperament model emphasizes. This is a neural network that enables control of attention, including the ability to redirect attention even when the stimulus situation pulls for the child's attention (Rothbart & Posner, 2005). In terms of strategies, it is this network that enables the use of distraction, which is redirection of attention (Grolnick et al., 1996). The executive attention network is located in the anterior cingulate and frontal areas of the human brain and evidence supports the view that it serves as the biological basis for both effortful control and important aspects of self-regulation (Bridgett et al., 2013; Rothbart & Posner, 2005). In addition to supporting distraction, which requires attentional control, this system is also implicated in the ability to modulate thoughts and emotions in other ways, including the ability to monitor conflicting stimuli (Rothbart & Posner, 2005).

Grolnick et al. (1996) conceptualized children's self-regulation strategies in terms of their attentional focus. As presented earlier in this thesis, young children's strategies that focus the least on emotionally salient stimuli are correlated with the least emotional distress. Specifically, six emotion regulation strategies are included and correlated with children's emotional displays. The six strategies are: active and passive engagement, cognitive and physical self-comforting, physical proximity to others, and fixation on emotionally salient stimuli (Grolnick et al., 1996). Results showed that active distraction was inversely related to emotional

distress, while fixation on emotionally salient stimuli (i.e., failure to redirect attention) was correlated with less distress (Grolnick et al., 1996). Although these strategies were conceptualized as on a continuum, they were not analyzed on a continuous scale. Nonetheless, the findings support the prediction that higher levels of effortful control, which are associated with greater modulation of attention, thoughts, emotions, and behaviors, should be associated with more sophisticated self-regulation strategy use (Grolnick et al., 1996; Rothbart et al., 2004).

Relevant to the context of the present study, effortful control should play a role in fear-regulation. In the context of fear-inducing situations, individuals rated as having higher levels of effortful control should be able to overcome their fear and hesitation and approach potentially threatening stimuli by either redirecting their attention to the potential benefits of engaging with the stimuli and/or by engaging inhibitory control to stop prepotent readiness to avoid the situation (Ahadi et al., 1993). This view is supported by evidence that children who are higher in both negative affectivity and effortful control do not exhibit the same strong attentional bias to threatening stimuli as children who are higher in negative affectivity but lower in effortful control (Lonigan & Vasey, 2009). Therefore, temperamental effortful control may protect against the predisposition toward threat, and the resulting emotion expressions and behaviors associated with being higher in negative affectivity in fear-inducing situations (Ahadi et al., 1993; Lonigan & Vasey, 2009).

In sum, the temperament dimensions of negative affectivity, extraversion/surgency, and effortful control should predict young children's expressions of negative and positive emotions, and the degree to which they engage their cognitive resources in their strategy use, during a fear-eliciting task (Kopp, 1982; Rothbart et al., 2004). Moreover, in some cases, the level of effortful control, an index of temperamental regulation, may moderate the effect of the reactivity

dimension of negative affectivity (Ahadi et al., 1993; Lonigan & Vasey, 2009). The present study aims to address these predictions. Additionally, the present study aims to address the previously discussed literature gaps by avoiding shared method bias, assessing these predicted relations among typically developing children, and contributing to clarification of relations among all three temperament dimensions and self-regulation strategy use.

The Present Study

The present study aims to address gaps in knowledge of temperament and early childhood self-regulation by determining the extent to which distinct dimensions of temperament are associated with strategy use scores for self-regulation. Specifically, negative affectivity, extraversion/surgency, and effortful control are analyzed with respect to the intensity (i.e., average level of engagement) and dominance (i.e., amount of time spent engaged) of children's emotions (fear, anger, and sadness) and strategy use (in terms of the extent to which cognitive resources are engaged). Several hypotheses are proposed:

(1) Higher mother-reported scores on temperamental negative affectivity will be associated with lower mean strategy level and dominance scores in strategy use.

(2) Higher mother-reported scores on temperamental extraversion/surgency will be associated with higher mean strategy level and dominance scores in strategy use.

(3) Higher mother-reported scores on temperamental effortful control will be associated with higher mean strategy level and dominance scores in strategy use.

(4) Higher mother-reported scores on temperamental negative affectivity will be associated with higher mean negative emotion intensity and dominance scores, primarily including fear due to the nature of the task, and potentially sadness and anger.

(5) Effortful control will moderate the hypothesized relation between negative affectivity and negative emotion scores, such that greater effortful control will weaken the predicted correlation between negative affectivity and negative emotion intensity.

These hypotheses are tested using mother reports of child temperament and laboratory observations of child emotion expression and strategy use. This approach avoids the potential bias of shared method variance that is a common limitation in many studies of child temperament and self-regulation or emotion regulation.

Chapter 2

Methods

The present study is part of the larger Dynamics of Self-Regulation Study (Cole et al., 2019). Presented here are the procedures, measures, and coding schemes used to collect data specifically for the Novel Boxes procedure.

Participants

Participants in this cross-sectional study (Dynamics of Self-Regulation Study; Cole et al., 2019) were 158 children (49.1% female) age 30 to 60 months (MAge = 45.19, SDAge = 8.20) and their caregiver(s). Families recruited from communities in central Pennsylvania had, on average, annual income of $89,665 (SDIncome = $50,210). The children mostly resided in two-parent homes (89.9%) and their parents identified them as White (94.3%), Asian (2.5%), Black (1.3%), and Native American (0.6%). Most parents had at least some college education (83.35%) and described themselves as working full-time (65.4%), working part-time (11.95%), working and attending school (1.85%), attending school full or part-time (1.6%), or unemployed (13.8%). Both caregivers (mother and father in most cases) were encouraged to participate in the study visit. While baseline questionnaires were completed by both parents in 92.41% of families, only 64.8% of study visits were attended by both parents, 34.6% were attended by mothers only, and 0.6% were attended by fathers only.

Procedure

Families with children aged 30 to 60 months were recruited through the Penn State Child Study Center Participant Pool (FIRSt Families), flyers, events, and various community events

(e.g., art and craft festivals, egg hunts, holiday festivals) to take part in a study of children's development of self-regulation. Families that expressed interest were contacted by phone and email and screened for eligibility (child in the desired age range). Inclusion criteria included: (1) The child does not have any developmental problems or health concerns that would interfere with their ability to provide valid data (e.g., cognitive limitations, intellectual disability, deafness); (2) The family speaks English well enough to understand and complete the tasks; and (3) The parents are the child's legal guardian (e.g., biological parents, stepparent, adoptive parent, legal guardians). If the family met criteria for inclusion and were, after hearing more about the study, still interested in participating, the family (child, mother, and/or father) were invited to and scheduled for a 4-hour laboratory visit during which trained staff administered tasks commonly used to assess child and adult self-regulation alternated with enjoyable tasks (e.g., free play, snack break). When a father or mother was unable to join the visit, one-parent-and-child visits were completed (usually lasting about 3 hours). In the week prior to the visit, mothers and fathers were emailed links to a pre-visit web-based (Qualtrics) questionnaire that included measures of adult temperament and child temperament.

Upon arrival at the laboratory, the family was met by a member of the research staff who explained the general layout of the procedures and obtained written informed consent to participate from the parent(s). The research staff then recorded each family member's height and weight using a tape measure and scale and got each member of the family situated with a set of physiological sensors. The child, mother, and father were then taken through a series of tasks, sometimes alone and sometimes in pairs, over the next 3 or 4 hours. The Novel Boxes procedure was the first child-only task, which followed the child-and-mother tasks and preceded the child-and-father tasks. Different research assistants were responsible for administering tasks to the

child alone or to a parent-child dyad, the parent-only tasks, monitoring physiological data collection and video recordings within the equipment control room, or playing particular roles in a few anxiety-provoking tasks (e.g., novel stranger, speech evaluator). At the end of the visit, the family was brought together and debriefed. After the physiological sensors were removed, the child received gifts and the parents signed additional consent and compensation forms.

Stranger Approach and Novel Boxes (Child-Only)

After the child-and-mother tasks were completed, the child and mother were given 5 minutes for free play, after which the research assistant (RA) returned and joined the play. The RA then instructed the mother to quietly leave the room. The RA then showed the child pictures of two prizes and instructed the child to choose a prize for the next game. After the child chose a prize, the RA also left the room. The child remained in the room playing with free play toys. Then, a female stranger wearing a dark hoodie and baseball cap entered the room, approached the child, and asked a series of questions in a monotone voice, pausing for 10 seconds between questions (e.g., “What is your name?”; “How are you today?”). The novelty of the situation was upgraded in phases after giving some general instructions about the task. After asking the child to sit in a chair located on the far side of the room, the stranger brought the first box, a scary and “heavy” box that looked like a bear and made a growling noise, into the room, placed it on a table a few yards from the child, and instructed the child to retrieve a key out of the box. Many children approached the box and retrieved the key. If the child did not retrieve the key within 20 seconds, the stranger prompted the child by saying “I don’t know what is in here, maybe one of the keys is. Come and see what is inside.” If, after this prompt, the child moved from their chair, but did not retrieve the key after another 20s, the stranger prompted again with “I don’t know

what is in there. Come and see if a key is in the box." If the child still did not approach the box, the stranger retrieved the key and handed it to the child so they could put the key on a key mat and return to the chair. The stranger then brought the second box into the room, placed it on the table and instructed the child to retrieve the second key from it. This box, which looked like a dinosaur and made a dinosaur noise, was (by all appearances and the stranger's expressions and actions) scarier and heavier than the first box. After whatever prompting was necessary, the child either retrieved the key and put it on the key mat, or the stranger retrieved the key and gave it to the child to put on the key mat. The stranger then brought the third box into the room, placed it on the table and instructed the child to retrieve a key out of the box. This box, which looked like an octopus and made no sound, was even scarier and heavier than the last. Once the child retrieved all 3 keys, the stranger gave the child a prize. Total time for all segments of the Novel Boxes procedure ranged from 2.37 to 8.88 minutes. Children's behaviors were videotaped throughout the task.

After the Novel Boxes procedure was completed, the familiar RA returned to the room, presented the child with a bin of toys and played with the child for 5 minutes.

Measures

Behavioral Coding

Children's emotional expressions and behaviors were rated on a second-by-second basis by independent teams. Coders on all teams were trained to at least 70% agreement (or an ICC of .70 for continuous variables) with master coders before coding, and met weekly during coding to resolve questions and receive general feedback. Interrater reliability estimates, using interrater class correlations, were calculated for 20% of the cases; reliability cases were assigned

throughout the whole period of coding to avoid observer (coder) drift. Based on reliability cases for Emotion Team and Engagement of Cognitive Resources Team, intraclass correlation coefficients were 0.6 or greater. For each emotion and for engagement of cognitive resources in strategy use, two variables were generated for each task segment: (1) Intensity, i.e., average rating across seconds for the task segment, (2) Dominance, i.e., proportion of task segment in which child received a score > 0. For engagement of cognitive resources, a second dominance score was generated for scores > 1, reflecting at least some cognitive engagement, as detailed below.

Emotion

Children's happiness, anger, sadness, and fear were rated second-by-second using Continuous Affect Rating and Media Annotation (CARMA; Girard, 2014) software. Only anger, sadness, and fear are analyzed in the present study. Raters were trained to use nonverbal cues to identify specific emotions, namely facial expressions, tone of voice, and postural/gestural cues. Each emotion was coded in a separate pass and, once identified, rated for intensity on a scale from no emotion (0) to intense emotion (4, e.g., exuberant, irate, depressed, or frightened).

Engagement of Cognitive Resources

Children's behavior was rated second-by-second using DataVyu (DataVyu Team, 2014) software. Behavior was rated on a 5-point (0-4) rating scale for the presence of strategies and the extent to which strategic behavior appeared to engage cognitive resources. The rating scale reflected no behavior (0, sitting or standing with no apparent focus or action), strategy use that did not engage cognitive resources (1, e.g., thumb-sucking, rubbing eyes), strategy use in which

minimal cognitive engagement was implied (2, e.g., asking for help or information, unfocused distraction), strategy use in which clear cognitive engagement was implied (3, explaining to research assistant why her help is needed, using simple emotion terms, focused distraction, i.e., absorbed in another activity such as making faces in the one-way mirror) and strategy use in which elaborated cognitive engagement was implied (4, reframing situation in a positive light, verbalizing problem-solving strategies, focused distraction if it involves imaginative play; Galyer & Evans, 2001; Lillard et al., 2013)

Seconds during which the research assistant interrupted the task (e.g., to replace sensors) are not rated and considered missing. If a child moved off camera and was not speaking, raters used information from the moments directly before and after being off camera. However, if no assumption could be made, those seconds were coded as missing (e.g., the child left the room).

Child Temperament

Prior to the visit parents completed the Child Behavior Questionnaire-Very Short Form (CBQ-VSF; Putnam & Rothbart, 2006). Only mothers' reports of children's temperaments were analyzed in the present study due to more mothers than fathers participating in the study.

The CBQ-VSF is a 36-item version of the longer Child Behavior Questionnaire (CBQ; Rothbart et al., 2001) and is shown to reliably measure the three temperament dimensions. Each subscale has 12 items, each rated on a 7-point Likert-type scale (Putnam & Rothbart, 2006). The Extraversion/Surgency subscale (Cronbach's $\alpha = 0.75$) describes children's predisposition to high approach, high energy, elevated tolerance for high-intensity stimuli, and impulsivity (e.g., "Likes going down high slides or other adventurous activities"). The Negative Affectivity subscale (Cronbach's $\alpha = 0.75$) describes children's tendency towards negative emotionality and

low soothability (e.g., “Gets angry when s/he can't find something s/he wants to play with”). The Effortful Control subscale (Cronbach’s $\alpha = 0.66$) reflects children’s predisposition towards inhibitory control, low tolerance for high-intensity stimuli, and heightened attentional capacities (e.g., “Is good at following instructions”) (Putnam & Rothbart, 2006).

Chapter 3

Results

This study tested several hypothesized relations between maternal reports of children's temperament dimensions and children's observed level of engagement of cognitive resources in the strategies they used during a 4-stage novel task designed to elicit fear. Hypothesis 1 states that higher mother-reported Negative Affectivity is associated with lower mean strategy level, both in terms of the average intensity of engagement of cognitive resources and of the dominance of any higher order strategies, i.e., time spent in higher order engagement of cognitive resources, during each segment of the task.

Hypothesis 2 states that higher mother-reported Extraversion/Surgency is associated with both higher mean intensity scores and higher dominance scores for strategy level. Hypothesis 3 states that higher mother-reported Effortful Control is associated with higher mean intensity scores and higher dominance scores for strategy level.

Hypothesis 4 states that higher mother-reported negative affectivity will be associated with higher mean intensity scores and dominance scores for fear, and potentially sadness and anger. However, Hypothesis 5 states that the bivariate association in Hypothesis 4 may be moderated by mother-reported Effortful Control in that the association between Negative Affectivity and intensity of children's negative emotion in each task segment will be lessened by higher mother-reports of child Effortful Control.

Although temperament scores were normally distributed, emotion intensity and dominance scores were skewed to a degree that could not be corrected using transformations. As a result, the hypotheses were tested with non-parametric statistics, namely Spearman's rank

correlations to test hypothesized bivariate associations (Hypotheses 1 through 4) and linear regression analysis to test the moderation prediction (Hypothesis 5).

The results section is organized by first presenting descriptive statistics for all strategy and emotion scores followed by presentation of the three temperament dimension scores. Second, results of Spearman's rank correlations testing Hypotheses 1 through 4 are presented. Finally, results of the linear regression testing Hypothesis 5 is presented.

Descriptive Statistics

Table 1 presents descriptive statistics for strategy level and emotion intensity and dominance scores. Notably, children's mean strategy intensity scores in each task segment indicate that children engaged in behaviors that constitute the lower end of the 0-4 strategy level range. In addition, children's mean strategy dominance scores indicate that children tended to engage cognitive resources (i.e., strategy level > 1) for about half of each task segment.

Children's mean emotion intensity scores for each emotion in each task segment also indicate that emotion expressions occurred in the lower range of the 0-200 intensity scale, reflecting mild intensity. Among the three negative emotions studied, fear was observed most often, followed by sadness, then anger. Again, the mean intensities indicate that for most children the displays of negative emotion were of mild intensity. In terms of dominance, fear was displayed for more than half of each segment, while sadness was displayed for less than half of each segment. Importantly, these descriptive statistics support the assumption that the novel task achieves the goal of being a fear-eliciting task. In contrast to fear, anger intensity and dominance were uncommon.

Table 1: *Descriptive Statistics for Strategy Level and Emotions*

Segment	Strategy Level			Fear		Anger		Sadness	
	Int	Dom > 0	Dom > 1	Int	Dom	Int	Dom	Int	Dom
Stranger									
M	1.69	.84	.63	15.57	.58	.68	.04	11.10	.38
SD	.54	.15	.25	15.80	.38	4.32	.19	22.25	.40
Min	.33	.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Max	2.89	1.00	.98	84.23	1.00	47.96	1.00	145.78	1.00
Box 1									
M	1.30	.68	.52	33.91	.66	.70	.04	24.04	.51
SD	.44	.21	.21	28.31	.34	3.15	.15	38.30	.40
Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Max	2.08	1.00	.89	135.72	1.00	23.10	1.00	187.44	1.00
Box 2									
M	1.37	.74	.55	24.73	.54	.57	.03	20.39	.45
SD	.42	.20	.20	26.28	.37	3.94	.14	36.61	.41
Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Max	2.19	1.00	1.00	136.35	1.00	41.60	1.00	184.39	1.00
Box 3									
M	1.33	.72	.53	24.49	.53	.48	.03	21.62	.44
SD	.44	.21	.22	30.81	.42	3.90	.15	38.04	.43
Min	.24	.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Max	2.36	1.00	1.00	159.29	1.00	43.38	1.00	190.49	1.00

Note. **Int** = Intensity (average score); **Dom** = Dominance (% of seconds observed); **Dom>0** = Dominance (% of seconds observed) of strategies of level > 0; **Dom>1** = Dominance (% of seconds observed) of strategies of level > 1

Table 2 presents descriptive statistics for maternal reports of children's temperament dimensions. Mothers described their children, on average, as above the possible mean (possible range of 1-7, mean = 4) on all temperament dimensions. However, the descriptive statistics indicated individual variability that enabled the testing of the hypotheses.

Table 2: *Descriptive Statistics for Temperament Dimensions (Mother CBQ-VSF Ratings)*

	Surgency	Negative Affectivity	Effortful Control
M	4.63	4.08	5.11
SD	.75	.83	.64
Min	2.41	2.30	3.22
Max	6.83	6.25	6.92

Spearman's Rank Correlations

Table 3 presents the results of testing Hypotheses 1, 2, and 3 using Spearman's rank correlations between maternal reports of child temperament dimensions and observed level of engagement of cognitive resources in strategies (strategy level scores). Only one of the three hypotheses was supported.

Only Extraversion/Surgency (Hypothesis 2) achieved partial support in the association between that temperament dimension and observed level of cognitive engagement in children's strategy use. Specifically, mother-reported Extraversion/Surgency was correlated with both children's observed mean strategy level and dominance scores for strategy level > 1 (engagement

of at least some cognitive resource) in each novel box segment. In addition, the dominance score for strategy level > 0 (i.e., including strategy level 1) was associated with Extraversion/Surgency, but only in the second task segment (Novel Box 1). Finally, contrary to Hypothesis 2, Extraversion/Surgency was not associated with strategy level mean intensity or dominance scores during the Stranger Approach segment (Segment 1) of the task. In sum, there was some support for Hypothesis 2.

Hypothesis 1 was not supported. Negative Affectivity was not associated with strategy level mean intensity or dominance scores. Similarly, Hypothesis 3 was not supported; Effortful Control was not related to mean strategy level intensity, although an inverse relation of small magnitude during the fourth task segment (Novel Box 3) reached significance. Moreover, instead of the predicted association, Effortful Control was *inversely* correlated with strategy dominance scores, specifically the dominance score reflecting at least some engagement of cognitive resources (i.e., strategy level > 1); these relations occurred only for the third and fourth task segments (Novel Boxes 2 and 3).

Table 3: *Spearman's Rank Correlations: Temperament Dimensions and Strategy Level*

P1 Temperament	Strategy Level		
	Int	Dom > 0	Dom > 1
Stranger			
Negative Affectivity	.055	.016	.063
Surgency	-.027	-.002	-.055
Effortful Control	-.026	.003	-.011
Box 1			
Negative Affectivity	.041	-.001	.030
Surgency	.216**	.094	.195**
Effortful Control	-.019	.038	-.049
Box 2			
Negative Affectivity	.080	.104	.092
Surgency	.358**	.222**	.358**
Effortful Control	-.117	-.099	-.147*
Box 3			
Negative Affectivity	.028	-.047	.133
Surgency	.176*	.081	.210**
Effortful Control	-.154*	-.081	-.171*

Note. **Int** = Intensity (average score); **Dom>0** = Dominance (% of seconds observed) of strategies of level > 0; **Dom>1** = Dominance (% of seconds observed) of strategies of level > 1

**. Correlation is significant at the 0.01 level (1-tailed).

*. Correlation is significant at the 0.05 level (1-tailed).

Table 4 presents the results of testing Hypothesis 4 using Spearman's rank correlations between maternal reports of child temperamental Negative Affectivity and observed intensity and dominance of fear, anger, and sadness. Hypothesis 4 was not supported. Negative Affectivity was not related to mean emotion intensity or dominance scores, apart from a small, significant inverse relation between Negative Affectivity and mean fear intensity that was present during the first task segment (Stranger Approach).

Table 4: *Spearman's Rank Correlations: Negative Affectivity and Emotions*

Emotion	**Negative Affectivity**			
	Stranger	**Box 1**	**Box 2**	**Box 3**
Fear				
Int	-.138*	-.088	-.108	-.090
Dom	-.034	-.075	-.043	-.006
Anger				
Int	-.074	-.079	-.124	-.101
Dom	-.071	-.084	-.126	-.103
Sadness				
Int	-.016	-.114	-.131	-.098
Dom	-.009	-.099	-.113	-.104

Note. **Int** = Intensity (average score); **Dom** = Dominance (% of seconds observed)

**. Correlation is significant at the 0.01 level (1-tailed).
*. Correlation is significant at the 0.05 level (1-tailed).

Stepwise Regression

Table 5 presents the results of testing Hypothesis 5 using stepwise regression, to assess whether mother-reported temperamental Effortful Control moderates the relation between mother-reported Negative Affectivity and the intensity of children's negative emotions. Due to the fact that children's fear intensity scores were higher than for sadness or anger, only the negative emotion of fear was analyzed. Because the magnitude of the association between Negative Affectivity and children's average observed fear was low for each task segment (only 1 correlation reached significance) a composite fear intensity variable was computed. This variable was computed by summing children's average fear intensity scores across the four task segments. This composite score affords more variability for testing the hypothesis.

Hypothesis 5 was not supported. In fact, the predictor variable Effortful Control did not meet inclusion criteria due to a lack of sufficient variance being accounted for. As a result, the predicted moderating effect of Effortful Control on the hypothesized relation between mother-reported Negative Affectivity and observed fear intensity could not be tested. The predictor variable Negative Affectivity did meet inclusion criteria and showed a significant inverse relation with the sum of children's average observed fear intensity across all task segments.

Table 5: *Linear Regression: Negative Affectivity and Total Fear*

Effect	Estimate	SE	95% CI		p
			LL	UL	
Negative Affectivity	-.189	8.146	-34.614	-2.404	.025

Note. Due to lack of sufficient association, Effortful Control did not meet the criteria for inclusion in an SPSS stepwise regression. Therefore the interaction was not tested.

Chapter 4

Discussion

The purpose of this thesis is to address a gap in the study of early childhood self-regulation, namely that children's temperamental characteristics are associated with the extent to which they engage cognitive resources as they confront an unexpected, novel situation. This thesis tests hypothesized relations between maternal reports of children's temperament dimensions and the extent to which they (a) react emotionally to a novel, fear-eliciting task and (b) recruit cognitive resources in the strategies they use to cope with the situation. This study uses a combination of parent report and observations to avoid the shared method variance in other studies of child temperament and emotion regulation. It also capitalizes on a new approach to conceptualizing and measuring children's strategy use in terms of their engagement of cognitive resources (Cole et al., 2019). The findings provide mixed support for the hypotheses; specifically, and as detailed below, Hypothesis 2 receives partial support and Hypotheses 1, 3, 4, and 5 are not supported.

Extraversion/Surgency

Extraversion/surgency involves a predisposition to high energy levels, positive emotions, and uninhibited approach including in the context of novel stimuli (Rothbart, 2007; Rothbart et al., 2001; Rothbart et al., 2004). Hypothesis 2 states that mothers' perceptions that their children are more extraverted and surgent are associated with greater engagement of cognitive resources in children's strategy use, both in terms of the average level of cognitive engagement as well as the amount of time that children spent engaging those resources. Across all phases of the Novel Boxes procedure, children's extraversion/surgency scores are significantly related with the

average level of cognitive engagement and the amount of time they spent thus engaged. This result aligns with previous research linking extraversion/surgency to diminished inhibition and fear and to greater task approach and engagement in the presence of other novel situations (Calkins et al., 1996; Stifter et al., 2008).

In the present study, however, engagement includes drawing on internal, cognitive resources and not just physical approach to novel persons or objects. That is, children who are more extraverted and approach-oriented also engage in behaviors that reflect their ability to interact verbally with the unfamiliar person about how to complete the task as well as to explore solutions to the task on their own. Moreover, the fact that time spent engaged in strategies that recruited cognitive resources (regardless of the level of engagement) is significantly correlated with extraversion/surgency is consistent with evidence that this temperament dimension is associated with more highly effective emotion regulation strategy use (Van Beveren et al., 2020). However, this thesis did not directly test the effects of strategy level on modifying children's fear. Notably it appears that the more mothers describe their children as extraverted and surgent, the less fear they displayed in the task. It may be that being less fearful allows more opportunity for engaging cognitive resources, or those resources are reducing fear.

Notably, and contrary to Hypothesis 2, being more extraverted and surgent did not relate to negative emotion or engagement of cognitive resources when children met the unfamiliar research assistant (Stranger Approach). Possibly, meeting someone who was neither expected nor explained to the child inhibited the tendency to approach that is the hallmark of extraversion (Rothbart et al., 2004). Therefore, more highly surgent children may only implement effective self-regulation strategies, suppress their inhibition, and engage with the novel stimuli of the task after initially adjusting to the fear-inducing, novel elements of the task.

Negative Affectivity

Negative affectivity describes a disposition in which a person is prone to perceive situations negatively and react with strong negative emotion (Rothbart, 2007; Rothbart et al., 2001; Rothbart et al., 2004). Hypothesis 4 states that higher mother-reports of negative affectivity are associated with higher observed levels of fear, and potentially anger and sadness. This hypothesis is not supported. Only one unexpected relation emerges; higher negative affectivity is associated with less, not more, fear during the initial phase of the task when children first meet the unfamiliar research assistant. Overall, negative affectivity is not related to observed levels or time spent displaying fear, anger, or sadness. This finding differs from several other studies showing that higher levels of negative affectivity are associated both with increased bias towards attending to threatening stimuli and with anxiety symptoms (e.g., Lonigan & Vasey, 2009). Thus, children high in negative affectivity should then experience heightened negative emotions, especially in the context of threatening stimuli (Calkins et al., 1996; Grolnick et al., 1996; Lonigan & Vasey, 2009; Rothbart et al., 2004; Santucci et al., 2008).

Hypothesis 1 states that higher maternal reports of children's negative affectivity are associated with lower average levels and time spent engaging cognitive resources. This hypothesis is not supported. Across all task segments, negative affectivity is not associated with the engagement of cognitive resources. This finding contrasts with previous research linking negative affectivity to inhibition in the context of fear and distressing stimuli, heightened internalizing behaviors, and the use of strategies bound to distressing stimuli, such as staring at the novel person (Behrendt et al., 2020; Calkins et al., 1996; Derryberry & Rothbart, 1997; Grolnick et al., 1996; Santucci et al., 2008). Given the method of coding children's strategy use used in the Novel Boxes procedure, it is necessary for children to actively engage with the task in

order to receive higher ratings for their engagement of cognitive resources. Therefore, the increased inhibition that has previously been linked to higher levels of negative affectivity should lead children to interact less with the task, and as a result receive lower ratings for cognitive engagement during the Novel Boxes procedure.

A potential underlying factor of these unexpected findings is that the effects of negative affectivity may be minimized by the heightened fear, and, to a lesser degree, sadness, elicited in most children during the Novel Boxes procedure regardless of their levels of negative affectivity. Results show that children expressed heightened fear and sadness across all phases of the Novel Boxes procedure. Both fear and sadness are emotions that define temperamental negative affectivity (Rothbart, 2007; Rothbart et al., 2001; Rothbart et al., 2004). Therefore, individual differences in cognitive engagement and emotion related to temperamental negative affectivity may have been masked during the Novel Boxes procedure.

Effortful Control

The effortful control dimension of temperament captures the extent to which a person can regulate their thoughts, emotions, and behavior (Rothbart, 2007; Rothbart et al., 2001; Rothbart et al., 2004). Hypothesis 3 states that children perceived as higher in effortful control by their mothers use strategies that draw more heavily on their cognitive resources, and are therefore better equipped to regulate their emotions, behaviors, and thoughts. This hypothesis is not supported for either average level of engagement or time spent engaging cognitive resources. Specifically, across the first three segments of the Novel Boxes procedure, effortful control is not related to children's engagement of cognitive resources. Moreover, unexpectedly, an inverse relation emerged during the last segment of the task. Specifically, for children whose mothers

describe them as higher in effortful control, the less children's behavior during the last novel box involved engagement of their cognitive resources. This finding contrasts with previous research linking effortful control to enhanced executive functioning, attentional control, and engagement in threatening situations (Ahadi et al., 1993; Bridgett et al., 2013; Grolnick et al., 1996; Lonigan & Vasey, 2009; Rothbart & Posner, 2005). Possibly, children higher in effortful control were more inhibited, that is, their effortful control led them to engage less in the task whereas the coding of engagement of cognitive resources necessarily required the children to be active (Delgado et al., 2018).

Hypothesis 5 states that effortful control will moderate, by weakening, the predicted relation between mothers' perceptions of their children's negative affectivity and children's observed fear. This hypothesis is not supported. Children's effortful control did not predict their combined average levels of observed fear across all phases of the Novel Boxes procedure. Contrary to this unexpected finding, research has shown that individuals with high levels of both effortful control and negative affectivity are able to direct their attention away from threatening stimuli to which individuals high in negative affectivity and low in effortful control are otherwise likely to attend (Lonigan & Vasey, 2009).

A potential explanation for the unexpected inverse relation between mothers' perceptions of children's effortful control and children's engagement of cognitive resources, as well as the failure of children's effortful control to predict their observed combined average fear, may lie in the fear-inducing context of the Novel Boxes procedure. Previous research has shown that higher levels of effortful control increase internalizing behaviors reported among children with higher levels of negative affectivity (Delgado et al., 2018). Because the Novel Boxes procedure has been shown to primarily elicit fear among the children who participated, it is possible that

effortful control may play a similar role in this context as in the context of high levels of negative affectivity. Specifically, in the context of fear, temperamentally or, in the case of the present study, contextually, effortful control may contribute to increased inhibition (Delgado et al., 2018). Such an interaction would lead children perceived as higher in effortful control by their mothers to engage less with the task, including both inhibited physical and cognitive engagement. This would lead children to have less opportunity to employ cognitive resources in order to overcome the threatening components of the task, as well as reduce opportunities for behavioral coders to capture children's use of strategies recruiting cognitive resources.

Limitations and Future Directions

While the present study has many strengths, including addressing several previously discussed gaps in the extant literature, there are also some limitations. First, this study relies on one brief observation to assess children's self-regulation strategy use and the extent to which those strategies engaged cognitive resources. However, mothers' ratings of their children's temperament are based on multiple observations of their children over the past six months. Perhaps a better test of the relations between mother-reported temperament and children's observed behavior would be to have multiple observations. Due to this discrepancy, it is possible that children's temperamentally-based individual differences in executive functioning may not have shown through during this relatively short task. Future studies may attempt to resolve this discrepancy by assessing both self-regulation and cognitive engagement over multiple observation periods.

A potential explanation for the fact that children's effortful control levels did not predict the extent of their cognitive engagement in the task may be that the task did not elicit the full

range of children's effortful control skills. That is, once children overcame their hesitancy to engage with the task after becoming acclimated to its novel elements, it is possible that the procedure of retrieving each key from the three novel boxes did not require the use of effortful control skills engaging higher levels of cognitive resources, such as inhibitory control. Future studies may address this by combining a more cognitively demanding task (e.g., a cognitive interference task) with the novel, threatening elements of the Novel Boxes procedure.

The present study relies on a convenience sample of parents and children in a university community who are interested in and willing to participate in a child development study. As a result, the sample is not representative of the United State population. For example, of the families included in the present study, most parents are college educated and employed in full-time jobs. Additionally, most of the sample identifies as White, while only small proportions describe themselves as Asian, Black, or Native American. Additionally, with respect to temperament, on average mothers rated their children highly in the dimension of effortful control, suggesting that the sample is relatively well-regulated. Future studies should aim to cultivate samples with greater socioeconomic and temperamental diversity.

Conclusion

The purpose of the present study is to examine relations among the temperament dimensions of effortful control, extraversion/surgency, and negative affectivity and the extent to which children's self-regulation strategies recruit cognitive resources. Findings suggest that the temperament dimension of extraversion/surgency is related to the engagement of children's cognitive resources in the context of fear and inhibition. The overall lack of relations between negative affectivity and both children's cognitive engagement and observed fear suggests that the

fear elicited in the Novel Boxes procedure may counteract the individual differences of children high in negative affectivity. The overall lack of a relation between effortful control and children's engagement of cognitive resources suggests that in the novel, fear-inducing context of the task, children high in effortful control may have responded with increased inhibition. Alternatively, this may be due to the fact that the task did not elicit children's full range of effortful control skills. In order to address the limitations of the present study, future studies should attempt to measure both temperament and self-regulation over similar periods of time, recruit a socioeconomically, racially, and temperamentally diverse sample, and incorporate a more cognitively demanding task into the novel, fear-inducing context of the Novel Boxes procedure.

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ACADEMIC VITA

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Education

2018 – 2022 **Schreyer Honors College, The Pennsylvania State University**
Bachelor of Science in Psychology, with Honors
Minor in Anthropology
Summa Cum Laude

Honors

2018 – 2022 **Provost's Award**, *The Pennsylvania State University*

2018 – 2022 **Academic Excellence Scholarship**, *Schreyer Honors College*

All semesters **Dean's List** (Semester GPA of 3.5 or higher), *The Pennsylvania State University*

Research

2020 – 2022 **Development of Emotion Regulation Lab**, The Pennsylvania State University
Director: Pamela M. Cole, Ph.D.
Project: Development of Self-Regulation Dynamics
Child Strategy Behavioral Coding Team Leader, Research Assistant

- Rate children's recruitment of cognitive resources in novel situations on a second-by-second basis using Datavyu
- Lead weekly coding team meetings to address coders' questions
- Manage coding team progress; assign cases to coders on a weekly basis
- Update coding manuals to reflect individual task differences
- Train new coders on the use of task-specific coding manuals
- Establish and maintain interrater reliability; oversee consensus coding
- Run reliability using R
- Attend weekly team leader meetings with principal investigators to address coding questions, give progress reports, discuss empirical articles
- Prepare data for finalization