THE STRUCTURE OF EFFORTFUL CONTROL AND ITS ASSOCIATIONS TO PSYCHOPATHOLOGY IN CHILDHOOD

By

Lisa Vroman

A DISSERTATION

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

Psychology-Doctor of Philosophy

2015

ABSTRACT

THE STRUCTURE OF EFFORTFUL CONTROL AND ITS ASSOCIATIONS TO PSYCHOPATHOLOGY IN CHILDHOOD

By

Lisa Vroman

The current literature investigating the structure of effortful control (EC) is mixed, as the results vary by the methods utilized. Much of the literature on the relation between EC and psychopathology indicates low levels of EC are most strongly associated with higher levels of psychopathology. Preliminary evidence, however, suggests a nonlinear association exists between EC and positive psychological outcomes. The aims of this study were twofold: 1) Examine the structure of trait EC assessed via parent report, experimenter ratings and objective coding of child behavior in response to lab tasks, and attentional control measures, and 2) Examine concurrent and predictive linear and nonlinear associations between EC and two common dimensions of psychopathology (externalizing and internalizing symptoms) in a sample ($n = 277$) of children between 3-7 years of age. The results generally support a unidimensional structure of trait EC in young children, with modest-to-moderate convergent validity between parent report, experimenter ratings, objective coding of child behavior, and attentional control measures providing additional support for this model. Trait EC (across most methods of assessment) exhibited concurrent, as well as a few prospective predictive relations with maternal reported externalizing and internalizing behavior problems on the CBCL.

ACKNOWLEDGEMENTS

My dissertation research would not have been possible without the help of many important individuals. I would first like to express my sincerest thanks to my advisor, Emily Durbin, for her continuous guidance during my graduate career. Emily's knowledge and enthusiasm for research have inspired me and her consistent positivity carried me through many challenging times. I would also like to thank my committee members, Brent Donnellan, Jason Moser, Zach Hambrick, and John Carlson for their assistance. Brent was particularly generous with his time and his passion for statistics was infectious.

This research project would not have been possible without the participation of the hundreds of families who completed the study. My gratitude goes to the members of the Child Emotion's Lab for their perseverance in coding endless hours of video and entering mounds of questionnaires. In particular, I would like to express my sincerest thanks to my fellow lab mates, Sharon Lo and Cait Listro for their camaraderie, friendship, and support throughout this process.

My time in graduate school was met with ups and downs and I am indebted to my fellow classmates for lending me encouragement, empowering me to persist even when I doubted myself, and keeping me company through many late nights. I feel particularly thankful to Zori Kalibatseva. Thanks for always having faith me, motivating me to be my best, and knowing how to put a smile on my face. My other fellow graduate students and dear friends, Brooke Bluestein, Katey Smagur, Jess Suisman, and Audie Black supported me and provided me valuable guidance in important moments in my life.

I am honored to have achieved this milestone on behalf of my family, particularly my parents and grandmothers, Vera Davie and Bea Burgan. My path to graduate school would not have been possible without you. Your love, faith in me, wisdom, and encouragement carried me through my graduate training. Lastly, I would like to thank my partner, Casey Stokes. Your love means the world to me. Words cannot express how thankful I am for your kind nature, generous spirit, and sense of humor. Thanks for being my rock.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCION

Temperament has broadly been defined as constitutionally based individual differences in attention, emotion, motor reactivity, and self-regulation (Rothbart & Derryberry, 1981). In childhood, temperament has been described in terms of three broad factors, Negative Affectivity, Extraversion/Surgency, and Effortful Control (EC; Rothbart, Ahadi, Hershey, & Fisher, 2001; Rothbart & Bates, 1998). EC refers to the ability to detect errors, plan, and make decisions in conflict tasks (Rothbart, 2007), and is thought to play a critical role in the modulation of reactivity (Rothbart & Bates, 1998), thus facilitating emotion regulation processes as well as other psychological mechanisms that require effortful modulation of behavior.

Effortful Control and Executive Functioning

EC is theoretically and operationally similar to executive functioning (EF), or the "higher order, self-regulatory, cognitive processes that aid in the monitoring and control of thought and action" (Carlson, 2005, p. 595), and is characterized by three core interrelated components: inhibition, information updating/monitoring in working memory, and shifting (Miyake, Friedman, Emerson, Witzki, & Howerter, 2000). There is substantial overlap in the operational definitions of EC and EF (Bridgett, Oddi, Laake, Murdock, & Bachmann, 2013; Zhou, Chen, & Main, 2012). For example, EC is highly similar to the descriptions of the EF of inhibition (i.e., inhibition of prepotent responses). Similarly, the executive attention network purported to underlie EC (Rothbart, Sheese, & Posner, 2007), which is responsible for monitoring and resolving conflicts, is closely related to definitions of the EF of information updating/monitoring (i.e., actively manipulating relevant information in working memory). Lastly, conceptual definitions of attentional control, the ability to effectively allocate and focus attention, highly resemble the characterizations of the EF of shifting (i.e., ability to effectively engage and disengage attention). Measurement of EC and EF also frequently overlaps, as both constructs can be assessed via questionnaires, behavioral measures, and neurocognitive tasks that generally tap aspects of neuropsychological functioning (e.g., Dimensional Change Card Sort, DCCS; Frye, Zelazo, & Palfai, 1995; Zelazo, Muller, Frye, Marcovitch, 2003). While we have not reached consensus on whether these two constructs are indeed the same, available data on the relation between EC and EF in child and young adult samples indicate moderate to substantial overlap between the two constructs (Blair & Razza, 2007; Bridgett, et al., 2013). As such, the literature on EF appears relevant to investigations on EC.

Structure of Child Temperament

Developmental models of temperament are increasingly converging on the idea that temperament is reliably comprised of at least three superfactors: Positive Emotionality (PE), Negative Emotionality (NE), and EC (Ahadi et al., 1993; Casalin, Luyten, Vliegen, & Meurs, 2012; Rothbart et al., 2001; Rothbart & Bates, 1998; Tellegen, 1985; Vroman, Lo, Durbin, 2014). Personality researchers generally use the Big Five model to describe the structure of personality in adults (John, Naumann, & Soto, 2008) and some evidence suggests this model may provide an equally valid structure of temperament in childhood (Caspi & Shiner, 2006). There are a variety of temperament models that include between two to four factors in children. Neurobiological models of temperament emphasize three factors, with EC comprising one factor (e.g., Rothbart et al., 2001). Rothbart's three-factor model of temperament is theoretically consistent with Tellegen's three-factor model of personality in adults, consisting of PE, NE, and Constraint (Tellegen, 1985), the last of which is similar to EC.

Much of the existing literature has adopted Rothbart's three-factor model. This model was born out of research grounded in the examination of the biological bases of individual differences and has clearly identified an EC factor, in contrast to other temperament models, which historically split attentional, behavioral, and motor control into separate factors. Thus, for the purposes of this study, we will adopt Rothbart's three-factor model. Support for Rothbart's model comes from an examination of the factor structure of the Children's Behavior Questionnaire (CBQ; Rothbart et al., 2001), a parent-report measure developed to provide a highly differentiated assessment of temperament for children ages 3-7 that assesses 15 temperament subtraits (e.g., impulsivity, attentional focusing). In this examination, the authors conducted a principal axis factor analysis with an oblimin rotation on the items from the CBQ on a sample of 4- to 7-year-old children. A three-factor solution (EC, PE, NE) fit the data best. This model has been widely accepted as evidence that common traits can fit a 3-factor model. Future studies are needed to investigate the structure EC to examine whether these EC subscales represent a unitary construct or distinct dimensions of EC.

Structure of Effortful Control

Similar to the debate on the structure of child temperament, researchers also have yet to reach consensus on the nature of EC. Most lab tasks and scales designed for children often are derived to tap different putative subdomains of EC, generally attentional and inhibitory control (self-control processes that serve to modulate (either increase or decrease) reactivity) (Rothbart et al., 2001). Rothbart (2004) argued that attention influences children's ability to inhibit reactive tendencies and engage in behaviors that will not result in immediate rewards. As such, attentional and inhibitory control subtraits are considered critical to the assessment of EC. Developmental influences may make it challenging to disentangle attentional and inhibitory control subcomponents in younger samples, as attentional control might be necessary for the development of inhibitory control. For example, in the first year of life, attentional orienting first serves to regulate distress (Harman, Rothbart, & Posner, 1997). Later in the first year of life, infants are capable of controlled attention, in contrast to the reactive attentional selection infants exhibited earlier in development (Rothbart, Posner, Boylan, 1990). This shift toward controlled attention underlies the voluntary control necessary to regulate behavior (Posner & Rothbart, 1998). Furthermore, it is possible that attentional control precedes and is highly inter-correlated with inhibitory control. Thus, it is possible that the interrelationship among different EC subtraits may change across development, which suggests the importance of evaluating the structure of EC across different developmental periods. For young children (ages 2-6), the available research on the structure of EC largely has drawn upon parent-report and lab tasks. While there is not yet consensus regarding the structure of trait EC, enough evidence has accumulated to draw some conclusions, which are discussed in the sections below.

Unidimensional Models. A unidimensional model of EC was supported by an investigation that administered eight laboratory tasks to assess EC via cognitive, motor, delay, and conflict tasks (i.e., Box Search Task, Delay of Gratification, Less is More, Gift Delay, Grass-Snow, Head to Toes, KRISP, Walk-a-Line Slowly) in a study of three-to-five year old children (Allan & Lonigan, 2011). For example, during the Delay of Gratification task, the examiner asked children if they would like to have the smaller immediate prize or delayed prize, which included multiple prizes. During the Grass-Snow task, children were instructed to point to a green block when the examiner said the word “snow” and to point to a white block when the examiner said the word “grass”. The authors tested four a priori models of EC (one single-factor model and three two-factor models) using confirmatory factor analyses (CFA). Bivariate correlations between each EC task indicated all measures were significantly correlated with one another with the exception of the Delay of Gratification task. This was task was removed from all analyses; the removal of the Delay of Gratification task did not significantly affect global model fit. Fit indices for the four CFA models revealed that a one-factor model fit the data best, as none of the three two-factor models provided a significant improvement in model fit, and the fit indices of the different two-factor models were similar to one another.

A second study examined the structure of EF (conceptually similar to EC) in five-year-old children (Willoughby, Blair, Wirth, & Greenberg, 2012). Children were administered six laboratory tasks assessing abilities such as working memory, attention shifting, inhibitory control, and inhibitory motor control (i.e., Working Memory Span, Pick the Picture, Spatial Conflict Arrows, Something's the Same, Silly Sounds Stroop, and Animal Go No-Go). A one-factor model exhibited good model fit, $\chi^2_{(9)} = 6.3$ ($p = .71$); CFI = 1.0, RMSEA = 0.00, RMSEA 95% CI [0.00, 0.03], $N = 1{,}036$. A two-factor model was also estimated whereby the three tasks designed to measure inhibitory control (Spatial Conflict Arrows, Animal Go No-Go, and Silly Sounds Stroop) and the one task designed to measure attention shifting (Something's the Same) loaded separately from the factor designed to assess working memory (Working Memory Span and Pick the Picture). This two-factor model also exhibited good fit indices, $\chi^2_{(8)} = 4.5$ ($p = .81$); CFI = 1.0, RMSEA = 0.00, RMSEA 95% CI [0.00, 0.02], $N = 1{,}036$. Both latent variances were statistically significant, and the two EF factors were positively correlated ($\phi = .89$, $p < .001$). The factor loadings for all tasks were statistically significant ($p <.0001$). The two-factor model did not statistically significantly improve model fit relative to the one-factor model, $\chi^2_{(1)} = 1.8$ ($p = .18$). Thus, a one-factor model was deemed most appropriate.

Finally, Sulik et al. (2010) explored the structure of EC in low-income preschoolers as assessed by teacher-report on the inhibitory and attentional focusing scales of the CBQ and laboratory tasks. The authors investigated the structure of EC across sex and ethnic groups (i.e., White, African American, and Hispanic). Children were administered seven behavioral measures: Knock Tap, Rabbit Turtle, Yarn Tangle, Gift Wrap, Waiting for Bow, Bird and Dragon, and Continuous Performance Task. CFAs of teacher reports of the inhibitory and attentional focusing scales of the CBQ and the seven behavioral measures of EC indicated a one-factor model was best fitting. A single-factor model fit the data equally well across gender and ethnic groups, and the factor loadings were not significantly different across the different groups. The particular tasks included in this investigation all appear most indicative of inhibitory control aspects of EC, that is, the ability to suppress prepotent responses, such as waiting for permission to open a present (e.g., Waiting for bow; Kochanska, Murray, & Harlan, 2000), and to a lesser extent motor and attentional control, or the ability to sustain attention on a given object/task (i.e., the Continuous Performance Task; Rosvold, Mirsky, Sarason, Bransome, & Beck, 1956). Therefore, it is unsurprising that a one-factor solution fit the data best.

In the domain of parent report, the structure of EC has been assessed via the CBQ. A second-order principal components analysis of the 5 EC scales included on the CBQ was conducted on a sample of 3-year-old children (Gusdorf, Karreman, van Aken, Dekovic, & van Tuijl, 2011). Similar to Rothbart et al. (2001), the authors determined the five EC scales (Attentional Control, Inhibitory Control, Perceptual Sensitivity, and Low Intensity Pleasure) loaded onto one factor, which accounted for 49.9% of the variance in parent reported EC.

Multidimensional Models. Conversely, support for a multidimensional model of EC comes from a four-year observational longitudinal investigation. In this study, assessments of

EC were conducted at three ages across toddler (2.5 years), preschool (4 years), and early school age (5.5 years) (Murray & Kochanska, 2002). The lab tasks were previously developed and validated (Kochanska, Murray, & Coy, 1997; Kochanska, Murray, Jacques, Koenig, & Vandegeest, 1996). The tasks assessed children's ability to delay activity (i.e., Snack Delay, Tongue, Dinky Toys, Home Gift, and Lab Gift), slow down fine and gross motor activity (i.e., Turtle and Rabbit, Walk-a-Line Slowly, Telephone Poles, Star, and Circle), modulate the volume of their voice (i.e., Whisper), suppress a dominant response to perform a subdominant response (i.e., Tower, Bear and Dragon, Simon Says, Pinball, Red-Green, exhibit effortful attention (i.e., Shapes), and exhibit cognitive reflectivity (i.e., KRISP). Similar EC batteries were administered at each age group. Principal components factor analysis with an oblique rotation revealed a unique, albeit similar factor structure at each of the three age groups examined. A two-factor structure at the toddler age fit the data best, accounting for 56.8% of the variance in EC scores; one factor (Delay/Gross Motor) included tasks that required children to slow or delay their motor behaviors, and the second factor (Suppress/Initiate) included those that required children to suppress a dominant response to perform a subdominant action. At the preschool age, a four-factor structure emerged (i.e., Delay, Gross Motor Control, Fine Motor Control, and Suppress/Initiate), accounting for 56.8% of variance; here, two new factors emerged related to the ability to slow down fine and gross motor movements. At early school age, the factors Motor Control and Suppress/Initiate fit the data best, which accounted for 54.6% of the variance in EC scores. Overall, the results indicate that the Suppress/Initiate and Delay (or Delay/Gross Motor) factors emerged consistently across the toddler to preschool age, and the Suppress/Initiate factor continued to emerge at each time point. However, it should be noted that the tasks administered in this study were largely assessments of inhibitory control.

Additional research was conducted utilizing a previously developed and validated lab battery described above (Kochanska, et al., 1997; Kochanska et al., 1996) with 4-6 year-old children (Dennis, Miller Brotman, Huang, & Kiely Gouley, 2007). The EC battery is designed to assess motor control, inhibition, and delay abilities. A CFA evaluating a one-factor model of EC demonstrated poor fit and low factor correlations (*rs* = .25-.30). CFAs assessing a two-factor model, with EC comprised of the subdomains Suppress/Initiate and Motor Control, demonstrated good model fit and moderate positive correlations between the two EC factors. A second study also administered the same EC lab battery to a slightly younger sample of 3-year-old children (Gusdorf et al., 2011). Principal components factor analysis with an oblique rotation revealed five-factor solution accounting for 65.5% of the variance in EC scores. The five-factor solution was comprised of Delay of Gratification (defined by the tasks Snack Delay, Gift-in-Bag, Wrapping, and Waiting for Bow), Fine Motor Abilities (characterized by Drawing Task and Whisper Task), Impulse Control (defined by Dinky Toys, Tongue Task, and Walk-a-Line-Slowly), Effortful Attention (characterized by Tower Task and Shapes Task), and Gross Motor Abilities (defined by the Turtle-and-Rabbit task). A second-order principal components factor analysis was conducted to evaluate whether these five components assess the same higher-order construct. The results revealed that the five components loaded on two factors, accounting for 52.2% of the variance. The first factor was identified by factor loadings for Delay of Gratification, Fine Motor Abilities, and Impulse Control, which reflected Self-Control. The second factor was identified by loadings of Gross Motor Abilities and Effortful Attention, thus labeled Attention/Motor Control. The results of this investigation overlap some with the model uncovered in the Kochanska et al. (2000) study (i.e., Delaying, Effortful Attention, Suppressing or Initiating Activity to Signal, Slowing Down Motor Activity, and Lowering Voice); however, there are aspects of this factor structure (e.g., the Drawing Task loading on one factor with the Whisper Task) that are difficult to interpret conceptually and do not align with previous research.

In summary, the total evidence to date remains inconclusive regarding the structure of EC. Some studies report that EC is best characterized by one dimension, others by several. Many existing measures of EC do not tap all of the components that are theoretically thought to be important to the construct (Rothbart et al., 2001). For example, many studies have focused exclusively on inhibitory control, rather than the attentional control aspects of EC. Similarly, those studies identifying a single underlying EC factor did not include reward delay tasks, in contrast those identifying a two-factor structure of EC, which often distinguish a delay factor from inhibitory control/attention factor. This may account for the observed differences between the uni- and multidimensional models of EC. In addition, existing results on the structure of EC vary depending on the methods employed, such that a unidimensional factor structure has been found using informant-report, while studies relying on laboratory tasks have uncovered both unidimensional and multidimensional factor structures. This further necessitates the need for additional research to clarify this issue in order to understand how method of assessment influences the structure of EC. To the extent that different methods converge on similar structural findings, we will have more confidence in these conclusions. If different methods produce different structural findings, then it is important to understand the relative construct and predictive validity of the different methods for assessing EC.

Method of Assessment

Multiple methods have been utilized to assess EC in children and adolescents, with questionnaires (self-, parent- and teacher-report), laboratory, and neurocognitive measures comprising the methodologies most frequently employed.

Questionnaires. Parent reports are the most common measure for assessing child EC, as they provide both an economical and efficient means of assessment. Parent report of child behavior allows for an examination of behavior in a wide range of contexts, which can combat limitations of structured laboratory tasks that are constrained to a limited number of contrived contexts. Consequently, many investigations of EC have relied heavily (or solely) on data from parent-report (e.g., Muris, 2006; Murphy, Eisenberg, Fabes, Shepard, & Guthrie, 1999).

Like all methods of assessment, however, parent-report is not without limitations. As noted by researchers (e.g., Kagan, Snidman, McManis, Woodward, & Hardway, 2002), there are several factors that may weaken the validity of parent-report. For example, parents who have not had much experience with children are at a disadvantage due to their limited basis for judging their child's behavior relative to norms. Additionally, parents also may vary in the comparisons they consider when rating their child's behavior, introducing error into measures of individual differences collected via these reports. These (and other) factors are important limitations to consider and highlight the importance of adopting a multi-method approach to the assessment of child EC to combat the limitations of any one method of assessment (e.g., Majdandzic & van den Boom, 2007).

In an attempt to address the aforementioned criticisms of parent-report, Rothbart and colleagues developed several questionnaires assessing temperament traits, including EC, from infancy through adulthood (Ellis, 2002; Ellis, & Rothbart, 2001; Evans & Rothbart, 2007; Garstein & Rothbart, 2003; Putnam, Garstein, Rothbart, 2006; Rothbart et al., 2001; Simonds, 2006; Simonds & Rothbart, 2004). These questionnaires inquire about parents' interpretations of their children's behavior in specific situations rather than global behavioral interpretations and caregivers are not required to make comparative judgments. Example items designed to assess

EC include, “can lower his/her voice when asked to do so”; “enjoys just sitting quietly in the sunshine”; and “has a hard time following instructions.”

Laboratory tasks. Kochanska and colleagues developed and validated one of the most widely administered EC lab batteries (Kochanska et al., 1996), consisting of 14 tasks that tap various facets of inhibitory control. The original study using this battery involved assessment at two time points: toddlerhood (26-41 months) and preschool (43-56 months). The seven tasks administered at the time one battery consisted of those tapping abilities to delay (i.e., Snack Delay, Tongue, Home Gift, Lab Gift), slow down motor activity (i.e., Turtle-and-Rabbit), suppress/initiate an activity (i.e., Tower), and lower one’s voice (i.e., Whisper). At the second time interval (preschool age), 14 tasks were administered, including the five tasks administered at the first time point, as well as new tasks developed to be more appropriate for an older age group (i.e., Dinky Toys, Walk-a-Line-Slowly, Telephone Poles, Circle, Bear and Dragon, Pinball, and KRISP). Each of the tasks administered at the second time point fell under the broad categories of delaying, slowing-down motor activity, suppressing/initiating activity to signal, or cognitive reflexivity (KRSIP); cognitive reflectivity was used to refer to impulsivity/reflectivity. EC scores from the lab battery demonstrated high internal consistency at each assessment point, and individual differences in EC across the two assessments were stable. The lab battery was also moderately associated with maternal reports of trait EC on the CBQ at each assessment point, providing evidence for the convergent validity of each assessment approach.

One drawback of the assessment battery developed by Kochanska and colleagues (1996) is the length of time it takes to administer (approximately two hours). Structured laboratory tasks require not only assessment materials but also staff trained on the measures and the time and space to carry out the assessment battery, as well as expertise and time required to code child behaviors during the tasks. In addition, the tasks developed by Kochanska et al. (1996) were designed to assess inhibitory control only. While additional research is needed to clarify the nature of EC, it possible additional dimensions of EC (e.g., attentional control) are not captured in this lab battery.

Researchers have not frequently used all of the aforementioned tasks in their study of EC, and have instead commonly used a few of these tasks or developed individual tasks for use in their own investigations (e.g., Eisenberg et al., 2010; Kieras, Tobin, Graziano, & Rothbart, 2005). Recently, a large-scale ($n = 602$) empirical investigation was published detailing lab tasks used to assess EF in children two-six years of age (Carlson, 2005). Each task required the children to inhibit a prepotent response, and each was meant to tap a specific facet of EF such as inhibitory control and attentional control, which are implicated in EC processes. The author conducted a cross-sectional analysis of children in five age groups (i.e., young and older 3-year-olds, young and older 4-year-olds, and five-year-olds) to assess the developmental sensitivity of 24 EF tasks. The convergent validity of these measures was not explicitly evaluated in this study; however, the tasks included in this examination (e.g., Snack Delay, Whisper) were developed in previous investigations (e.g., Kochanska et al., 1996) and many of these tasks had previously been shown to correlate with other temperament measures of EC, such as parental report. Of note, several of the tasks outlined in Carlson (2005) can be categorized as neurocognitive, rather than temperamental in nature, and thus will be discussed in more detail in the next section.

To summarize, laboratory assessments of EC provide a standardized method of assessment, such that the same tasks can be administered consistently across multiple research investigations. In addition, observational methods allow for a fine-grained, in vivo assessment of child behavior. Despite the development of standardized lab batteries by multiple research groups, relatively little work on the structure of EC has been completed using these batteries. Of the studies that have employed lab approaches, many have used tasks not previously validated, raising questions about reliability and validity. The development of new tasks also makes comparison across studies challenging.

Neurocognitive measures. Neurocognitive tasks designed to tap aspects of neuropsychological functioning underlying EF may provide another useful means of assessing individual differences in EC. This approach attempts to measure aspects of neuropsychological functioning (or volitional, purposive actions and effective performance) by assessing performance (e.g., accuracy) in response to test items; thus, they can be contrasted to lab tasks that are designed to elicit a range of behavioral responses that are later coded according to pre-determined coding schemes. Lab tasks designed to assess EC in children have focused largely on inhibition, and to a lesser extent attentional control. Furthermore, neurocognitive tasks would be an excellent supplement to lab tasks because they may more effectively assess attentional control and working memory, which are implicated both EC and EF abilities. As stated above, there is substantial overlap between EC and EF, though one notable difference between EC and EF is the context in which both constructs historically have been examined. EC, born out of the temperament literature, is generally assessed via emotionally laden tasks observed in the laboratory, tapping the "hot" aspects of higher-order cognitive functioning. In contrast, the assessment of EF in clinical psychology and cognitive neuroscience is typically assessed via emotionally neutral tasks, tapping "cool" aspects of higher-order cognitive functioning (Zelazo

& Carlson, 2012). The current investigation utilized both approaches to measurement and can therefore begin to address the issue of the whether EC and EF are the same construct.

The large-scale cross-sectional investigation of EF by Carlson (2005) described above included several tests that can be classified as neurocognitive, such as the DCCS (Frye et al., 1995; Zelazo et al., 2003) and the Shape Stroop (Kochanska et al., 2000). In the DCCS task, children are instructed to sort two colored shapes (i.e., a red rabbit and a blue boat) by one dimension first (either color or shape) and then the other dimension. EC is indexed by the number of correctly sorted cards, rather than coding of the child's style of response to the task. It would be useful to test convergence across the response-oriented scoring of EF tasks and the process-oriented measures of EC generated by lab tasks to further understand the nature of EC.

Neurocognitive tasks have also been developed to specifically assess executive attention, or the capacity to plan, engage in purposeful, goal-directed behavior, and the ability to anticipate consequences. It has been proposed that EC originates from the executive attention network (Posner & Rothbart, 1998; Rothbart, Derryberry, & Posner, 1994), which involves the anterior cingulate gyrus and lateral prefrontal regions of the brain (Fan, Flombaum, McCandliss, Thomas, & Posner, 2003; Fan, McCandliss, Fossella, Flombaum, & Posner, 2005). The flanker task is used most widely in cognitive psychology and was recently adapted for use with young children in the Attention Network Test (ANT; Fan, McCandliss, Sommer, Raz, & Posner, 2002), which assesses three dimensions of attention: alerting, orienting, and executive attention.

In summary, neurocognitive tasks most frequently assess executive attention (or attentional control), whereas laboratory tasks more commonly assess inhibitory control (particularly motor inhibition). The convergence between neurocognitive tasks and other methods of assessment (laboratory tasks and parent-report) is largely unknown. Neurocognitive measures are the least common method of assessment, with parent-report, and to a lesser extent, laboratory tasks the most frequently utilized method of assessment. Furthermore, neurocognitive measures are infrequently administered and are rarely paired with other methods of assessment.

Convergence across methods of assessment. The convergence of two methods of assessment of EC (i.e., questionnaire-lab tasks, questionnaire-neurocognitive tasks, and lab tasks-neurocognitive pairs) has not been widely examined. Most evidence for cross-method convergence comes from informant-report and lab tasks. Lab and parent-report measures converged modestly-to-moderately in several investigations (e.g., Kochanska et al., 1996; Kochanska et al., 1997; Kochanska et al., 2000; Muris, van der Pennen, Sigmond, & Mayer, 2008), implying acceptable-to-good convergence between methods. Evidence for convergence between parent-reported and lab-assessed EC is offered in an examination of the development of visual orienting in infants at 2, 3, and 4 months of age, infants' ability to visually disengage from a stimulus, demonstrate anticipatory eye movements, and use a cue to predict the location of a new target stimulus (expectations) was investigated and correlated (modestly-to-moderately) with maternal report on the Infant Behavior Questionnaire (IBQ; Johnson, Posner, & Rothbart, 1991). Specifically, infants who were able to readily disengage from a stimulus (a marker of visual orienting) were rated as less distress-prone and highly soothable (measures of NE). Conversely, anticipations were negatively, moderately correlated with soothability and expectations were positively, moderately associated with soothability; anticipatory eye movements were unrelated to parent-reported infant distress. The authors argue the development of attention is an important consideration as attention may serve a regulatory function over emotions. Modest convergence between maternal- and teacher-report on the CBQ and observed EC in early childhood has also been demonstrated (Valiente et al., 2003). EC was assessed via parent- and teacher-report on the CBQ at baseline and again two and 4 years later. Both parent- and teacher-report of EC was modestly-to-moderately positively correlated with a laboratory measure of EC.

The convergence between informant report and a performance-based attentional control has also been the subject of investigation (Verstraeten, Vasey, Claes, and Bijtterbier, 2010). Here, the convergent validity of EC questionnaires and a performance-based EC task, the Test of Everyday Attention for Children (TEA-Ch; Manly et al., 2001) was examined in children and adolescents between 8-17 years of age. Researchers administered questionnaires assessing temperament and attentional and effortful control as both a self-and parent-report form. Ceiling effects were observed on the TEA-Ch, which is not surprising, as the TEA-Ch was normed for children between 6.0-15.11 years of age – not up to 17 years of age. Self-report and performance-based indices of EC were moderately correlated in the youngest children (3^{rd} and 4^{th} graders) and a performance-based attentional control measure (TEA-Ch) was modestly correlated with psychopathological symptoms.

Finally, almost no information is available about the convergence between neurocognitive tasks and informant-report or lab tasks. One report found moderate correlations between Grass-Snow (Carlson & Moses, 2001), a neurocognitive measure of EC, and three lab tasks of inhibitory control, Gift Delay (Kochanska et al., 1996), Box Search (Simpson & Riggs, 2007), and Less is More (Carlson, Davis, & Leach, 2005).

In sum, despite considerable interest in EC and its development, the empirical literature has yet to catch up with theoretical models of this trait. Serious limitations include reliance on a few methods (chiefly parent report), a lack of knowledge about convergence across different methods of assessing EC, and the fact that most studies have solely examined one dimension of

EC, often inhibitory control (e.g., Moriya & Tanno, 2008; Muris, 2006). Furthermore, investigations examining multiple putative domains of EC are rarely undertaken. It will be critical for future research to fill these gaps in the literature to further our understanding of the structure of EC, associations with other methods of assessment, and external correlates.

Associations between EC and Internalizing and Externalizing Behaviors

Illuminating the association between EC and psychopathology has significant implications for our ability to identify children who may be at risk for adverse behavioral and psychological outcomes and to understand possible mechanisms involved in their development. EC may serve a regulatory function in the experience and manifestation of emotion. This implies that EC may be implicated in the development of psychopathology, namely internalizing and externalizing symptoms, as these disorders are thought to involve the capacity to effectively regulate affective states (e.g., Cicchetti, Ackerman, & Izard, 1995), as well as behavior. EC, thought to be comprised of inhibitory and attentional subcomponents, includes both the ability to suppress and initiate behaviors, as well as attend to environmental stimuli. These behaviors are consistent with theoretical conceptualizations of externalizing behaviors (i.e., low levels of inhibition and attentional control) and internalizing behaviors (i.e., high levels of inhibition and high (or low) attentional control). Furthermore, the nature of the association between EC and psychopathology is likely complex and the specific nature of the relationship has yet to be precisely delineated.

Unique effects of EC.

Both inhibition and inattention have been linked to externalizing behaviors from early childhood through adolescence. For example, parent-reported EC (on the CBQ) and lab assessments of EC have been shown to be negatively associated with externalizing problems on the CBCL in three-year-old children (Olson, Sameroff, Kerr, Lopze, & Wellman, 2005). The multi-method, multi-informant approach provides compelling evidence that low levels of EC confer risk of externalizing problems in preschool-aged children.

Further evidence for the association between EC and externalizing behaviors is provided by an examination of the symptoms of ADHD and the temperament traits of reactive control (defined as the automatic modulation of behavior and emotion, which is related to incentive response), which they distinguish from effortful control (defined as the deliberate modulation of behavior and emotion), resiliency, and emotionality (Martel & Nigg, 2006). The results revealed that reactive and effortful control, resiliency, and negative emotionality are differentially related to specific ADHD symptom domains. EC was unrelated to hyperactivity/impulsivity. Parent-report of inattention was related to low EC, which is consistent with Rothbart and colleague's (2001) conceptualization of attentional control as a subtrait of temperament related to EC.

The relationship between EC and internalizing symptoms is somewhat mixed, with some evidence suggesting high levels of EC are associated with internalizing symptoms, while other research indicates low levels of EC confer the greatest risk of internalizing symptoms. A modest association was detected between high levels of EC and internalizing problems in a sample of children from toddlerhood to early school age (Murray & Kochanska, 2002). Attentional control, a facet of EC, has similarly been linked to anxiety symptoms in sample of 9- to 17-year-old children and adolescents (Meesters, Muris, & van Rooijen, 2007), as well as both internalizing and externalizing symptomatology in middle childhood (Muris et al., 2008). Muris and colleagues (2008) asked youth between 8-12 years of age to complete self-report measures of attentional control and internalizing and externalizing symptomatology, as well as five subtests of the Test of Everyday Attention for Children (TEA-Ch; Manly et al., 2001). Attentional and effortful control were negatively correlated with self-reported symptoms, indicating that poorer self-regulation is associated with increased levels of psychopathology. Unlike self-report measures of attentional control, the TEA-Ch was not strongly associated with psychopathological symptoms. One possible explanation for this that only five subtests of the TEA-Ch were administered and all but one of these measures assessed attentional control.

The aforementioned research highlights the importance of selecting multiple methods (e.g., questionnaire and lab tasks) to assess both EC and external correlates. Much of the existing research uses a single method, typically parent report questionnaires, to assess both EC and psychological symptoms, thus inflating associations because of shared method variance. Thus, it is possible that some studies have overestimated the strength of EC's associations with psychopathology. For example, in one study, questionnaire assessments of EC were found to correlate with behavior problems assessed via questionnaire but not neurocognitive assessment (Verstraeten et al., 2010). Additional research utilizing multiple methods is needed to clarify the nature and magnitude of this relationship.

Nonlinear effects of EC. Some preliminary evidence contradicts the notion that higher levels of EC confer the best psychological outcomes, and supports a nonlinear (quadratic) association between EC and positive psychological outcomes. This nonlinear relationship was detected in a longitudinal study examining EC and mother-reported total behavior problems (on the CBCL; Achenbach & Edlebrock, 1983) from toddlerhood to early school age (Murray & Kochanska, 2002). Children with low and high levels of EC, as assessed by lab tasks, were found to have the greatest number of problem behaviors, in contrast to children with moderate levels of EC. A second study also detected a nonlinear association between EC (assessed via lab tasks) and emotion regulation (assessed via lab tasks), such that moderate levels of EC were associated with high levels of emotion regulation (Carlson & Wang, 2007). Moderate levels of

EC may be associated with the highest levels of emotion regulation, as high levels of EC may result in significant anxiety or fear about one's behavior, while low levels of EC may relate to subtraits such as impulsivity.

In summary, while nonlinear associations have only been detected to date in two investigations, the results suggest a more complex relation between EC and adaptive outcomes may exist. Indeed, these results are consistent with Block's conceptualizations of ego control and ego resiliency, which suggest high levels of ego resiliency and moderate levels of ego control are the healthiest (e.g., Block & Block, 2006). Ego-control (undercontrolled vs. overcontrolled behavior) is defined as an individual's characteristic tendency to act on their impulses. Ego-resiliency (adaptation vs. maladaptation) describes an individual's ability to quickly adjust to the demands of the environment and involves the ability to increase or reduce behavioral control according to situational demands. Block and Block (2006) acknowledge the advantages and disadvantages of falling on either end of the continuum of ego control (i.e. being too rigid vs. too impulsive) and therefore suggest high levels of behavioral control is not inherently preferable, whereas high levels of EC resiliency are desirable. Further research is needed in this area before we can form firm conclusions about the existence of nonlinear effects. It is possible a nonlinear association has not routinely been detected in previous studies due to the difficulty of EC measures to detect individual differences in EC at the tails of the distribution, or a failure to test for nonlinear associations. Additionally, it is critical that future research in this domain apply appropriate and rigorous tests of curvilinear effects. Of the limited research available, it has been common practice to divide groups into low, medium, and high levels of EC. This approach fails to control for a linear effect prior to inferring a nonlinear effect, and therefore is not the optimal method for examining this research question.

Summary. There are consistent links between low levels of trait EC and high levels of psychopathology (e.g., Muris, 2006; Muris et al., 2007; Muris et al., 2006). In addition, some preliminary evidence suggests moderate levels of trait EC are associated with fewer problem behaviors and increased emotion regulation (Carlson & Wang, 2007; Murray & Kochanska, 2002).

Conclusions and Directions for Future Research

Despite the important contributions of the literature to our understanding of the development of EC, future research should focus on addressing the methodological limitations of the current literature. A multi-method, multi-measure approach to the measurement of EC is particularly critical given that much of the available literature has relied on the use of one method, generally informant or self-report. Given the modest-to-moderate correlations between unique methods of assessment, a multi-method, multi-measure approach should be utilized to provide clarity about the nature of EC, as well as its associations with other variables of interest (e.g., externalizing symptoms).

Toward that end, the structure of EC has yet to be well validated. The lower-order factor model of child temperament derived by Rothbart et al. (2001) should be subjected to additional research to examine whether these lower-order factors (i.e., CBQ subscales) represent unique dimensions. This model arguably warrants additional research, as the development of this model was firmly grounded in the examination of the biological bases of individual differences. Additionally, this model has clearly identified an EC factor, in contrast to other temperament models, which have historically split attentional, behavioral, and motor control into other factors. Moreover, EC is theoretically comprised of attentional and activational subcomponents; however, an inspection of the laboratory and neurocognitive tasks most commonly assessed reveals that the EC tasks largely investigate cognitive or motor inhibition (e.g., Shape Stroop and Simon Says; see Carlson (2005) for a review). Relatively pure measures of attentional control are largely absent from the EC literature. Thus, the current research may not yet fully address the nature of EC, as the theoretical definitions and operationalizations of EC do not closely map onto one another. Indeed, the current literature elucidating whether EC is a multi- or uni-dimensional construct is mixed, as the results vary by the methods employed. The examinations that have determined EC to be a unitary construct relied heavily or exclusively on inhibitory control measures. It is therefore possible that these examinations failed to accurately assess EC (should EC be demonstrated to be multidimensional); however, it is also possible that the measures frequently used are poor measures of the construct. In order to make advancements in the field, valid measurement must be applied to the investigation of EC.

EC has also been linked to psychopathology, particularly in late childhood and adolescence. Much of the current research indicates that low levels of EC are most strongly associated with higher levels of psychopathology, particularly externalizing behaviors. However, this may be the result of EC laboratory batteries relying more heavily on measures of inhibitory control, rather than attentional control (e.g., Kochanska et al., 1996). Measures that assess attentional control are often hypothesized to relate to internalizing disorders such as anxiety and depression, however, this has not consistently been the case (e.g., Muris et al., 2008). In a young adult sample, depression negatively correlated with inhibitory and activational control, whereas social anxiety negatively correlated with attentional control (Moriya & Tanno, 2008). Additional research should strive to assess the dimensionality of EC and incorporate pure attentional control measures into laboratory assessment batteries (should this be a dimension of

EC) to test the hypothesis that associations between EC internalizing behaviors may be best be captured by attentional, rather than inhibitory measures.

Similarly, the nature of the association between EC and psychopathology is not fully understood. Most of the current evidence suggests children high in trait EC and either low or high in affective intensity are at least risk for negative developmental outcomes (Kochanska, Barry, Jimenez, Hollatz, & Woodard, 2009). Some preliminary evidence, however, supports a nonlinear (or quadratic) association between EC and positive psychological outcomes (e.g., emotion regulation) (Carlson & Wang, 2007; Murray & Kochanska, 2002). Conceptually, one might predict a nonlinear association between EC and adaptive child behaviors exists, as high levels of inhibition or attentional control may result in excessive behavioral restraint, while low levels of inhibition or attentional control may relate to subtraits such as impulsivity. While this research finding has only been detected in two investigations, it underscores the complex nature of the relationship between EC and adaptive outcomes, such as emotion regulatory capacities and adaptive behaviors. It is possible that a nonlinear association has not routinely been detected in previous studies because researchers have not tested for a nonlinear effect. Additionally, it is possible that a nonlinear association has not routinely been detected due to the difficulty of EC measures to detect individual differences at the tails of the distribution. Furthermore, a nuanced view of EC must be adopted to disentangle the complex relationships between EC and external correlates.

Specific Aims & Hypotheses

This study examined the factor structure of EC, as well as the concurrent and predictive associations between EC and two common dimensions of psychopathology (externalizing and internalizing symptoms) in childhood.

Specific aim 1: Examine structure of trait EC. We performed four exploratory factor analyses (EFA) to examine the structure of trait EC via unique methods of assessment: objective coding of child behavior from laboratory temperament tasks, experimenter ratings of child temperament throughout the lab battery, attentional control neurocognitive tasks, and parent report of child temperament on the CBQ. We then completed a series of confirmatory factor analyses (CFA) on the EC factors revealed from the four EFAs to determine if a multi-method battery produces evidence that EC is unidimensional or multidimensional. We report on the factor structure of each model, as well as the bivariate intercorrelations across methods between the emergent EFA factors, CFA factors, and external correlates (i.e., parent-report on the CBCL).

Specific aim 2: Examine nature of associations between EC and psychopathology. We examined the nature of the association between trait EC and parent-reported externalizing and internalizing symptoms on the CBCL. First, linear associations between trait EC and internalizing and externalizing behaviors (as indicated via parent-report on the CBCL at six-month follow-up) were examined. It was hypothesized that EC would be moderately negatively associated with parent-reported externalizing problems. It was also hypothesized that EC would be moderately positively correlated with internalizing parent-reported problems, both cross-sectionally and longitudinally, accounting for earlier parent reports of EC. Second, nonlinear associations between trait EC and internalizing and externalizing behaviors (as indicated via parent-report on the CBCL at first follow-up) were examined. Consistent with the hypotheses above, it was predicted that a quadratic relationship between EC and parent-reported internalizing behaviors would emerge, such that high and low levels of EC would be associated with the greatest number of internalizing behaviors, both concurrently and at the six-month follow-up.

CHAPTER 2

METHODS

Participants

Child participants were recruited from the greater Lansing, Michigan area for study of child temperament (*n* = 277). Children were between the ages of 3-7 years (*M* = 4.5, *SD* = 1.4), and 51% were boys. Data on ethnicity was provided by 65% of mothers and 41% of fathers. Of those, the ethnic composition was as follows: Caucasian/White (80%), Latino/Hispanic (9.4%), African American/Black (8.4%), bi- or multiracial (5.6%), Asian (2.2%), and other (1.7%); ethnic categories do not sum to 100% because participants could endorse multiple categories. Data on household income was provided by 63% of mothers and 39% of fathers. Yearly family income ranged from under $10,000 to greater than $100,000; 14.9% reported income less than $40,000. See Table 1 for further details on participant demographics. Children were administered the Peabody Picture Vocabulary Test (PPVT-II; Dunn & Dunn, 1997) at the beginning of the laboratory visit to assess their level of receptive language skills (*M* = 103.24, *SD* = 15.31). During the PPVT-II, children were shown sets of four pictures and asked to point to the picture that best depicts a word read orally by the experimenter. As children's completion of the lab tasks is partly dependent on their receptive language skills (or ability to understand experimenter prompts) and verbal ability itself is associated with EC, we examined whether PPVT-II performance was associated with performance on the lab tasks. Children's performance on the PPVT-II generally exhibited modest-to-moderate correlations with the EC factor scores; no significant correlations were observed between the PPVT-II and Digit Span and Letter-Number Sequencing. See Table 2.

Laboratory Assessment of Child Emotion and EC

Children completed 16 laboratory tasks designed to assess temperamental differences in positive and negative emotionality (PE and NE), and effortful control (EC). Seven tasks were taken from the Preschool version of the Laboratory Temperament Assessment Battery (Lab-TAB; Goldsmith, Reilly, Lemery, Longley, & Prescott, 1993), and eight tasks either were taken from previous investigations (i.e., Durbin, 2010; Durbin, Hayden, Klein, & Olino, 2007; Frye et al., 1995; Kochanska et al., 1996; Zelazo et al., 2003) or newly developed for work with this sample. A female experimenter administered all laboratory tasks and the tasks were administered in the same order across participants. The parent(s) of each child was present for all but four tasks (noted below). For each of the tasks the parent(s) was present for, they were asked to remain neutral. Breaks of approximately 2-4 minutes were taken in between each episode to allow children to return to a baseline emotional state prior to beginning the next task. Each of the 16 laboratory tasks is described below in the order they were administered.

Exploring new objects (Durbin, 2010; fear, happiness). The child was left to explore the room, which contained novel and ambiguous stimuli. The stimuli included a tunnel connected to a tent, an animal crate containing toy mice, a remote-controlled spider, a wooden box containing sticky “worms”, and a plastic skull hidden under a red cloth. The experimenter returned after 4.5 minutes and asked the child to touch each object.

Making a t-shirt (Durbin, 2010; engagement, happiness). The child decorated a t-shirt with puff paint and stamps. The child was allowed to take the t-shirt home as a gift at the end of the lab visit.

Dimensional change card sort (DCCS; Frye et al., 1995; Zelazo et al., 2003; EC). The child was informed that he/she would first play the color game, where he/she would be asked to sort each card along the dimension color. The child completed six trials (following two practice trials). The rules were repeated each trial. Regardless of the child's performance, the experimenter then informed the child they would play the shape game, where the child was instructed to sort each card along the dimension shape. The child completed six trials. Children who received five or six correct during the shape game proceeded to the border version. In the border version, some cards had a black border around the edge and some did not. The children were instructed to play the color game when given a card with a black border and to play the shape game when given a card without a black border. The rules were repeated each trial.

Stranger approach (Lab-TAB; Goldsmith et al., 1993; fear). The child was left alone briefly in the testing room. A male research assistant entered the room and spoke to the child in a neutral voice while gradually approaching the child and engaging in a scripted conversation. The child's parent(s) were not in the room for this task.

Impossibly perfect green circles (Lab-TAB; Goldsmith et al., 1993; anger, sadness). The experimenter repeatedly asked the child to draw green circles on a piece of paper while mildly criticizing each circle. After 2 minutes, the experimenter positively commented on the child's circles.

Popping bubbles (Lab-TAB; Goldsmith et al., 1993; activity level, happiness). The experimenter made bubbles with a bubble-shooting toy and encouraged the child to pop the bubbles.

Diorama snakes (developed in this sample; fear). The experimenter showed the child a tray filled with sand and grasses housing two remote-controlled snakes, and asked the child to touch the snakes. A second female experimenter (holding the remote controls out of sight of the child) made the snakes move. Following the child's response (e.g., touching the snake), the experimenter stated that they were just toys and demonstrated how to make them move using the remote controls.

Snack delay (Lab-TAB; Goldsmith et al., 1993; EC). The experimenter placed an M&M on a plate under a clear cup and informed the child that they could eat the M&M when the experimenter rang the bell. The experimenter rang the bell at eight predetermined time intervals (ranging from immediately to 30 seconds).

Picture tearing (sadness, guilt). The experimenter told the child that she would go and prepare the next game while the second experimenter shared pictures with them. The second experimenter then showed the child a series of pictures depicting a vacation home and a final picture showing her grandparents, whom she rarely sees because they live far away, emphasizing that this was her 'favorite picture'. The second experimenter left the room and the main experimenter re-entered and asked the child to tear up the second experimenter's favorite picture. This command was repeated up to three times. After the child's response, the experimenter exited the room. The second experimenter then returned to the room to retrieve her photo album. If the child tore the picture, she said, "Oh no! What happened?" The second experimenter then would leave the room to retrieve a second copy of the picture and would help the child put the new copy of the picture in the album. The main experimenter returned and emphasized that it was not a good idea to have asked the child to tear the picture. The child's parent(s) was not present in the room for this task.

Balloon bop (EC, happiness). The experimenter and child played a game in which they took turns hitting a balloon in the air. The child was told that they must keep their feet within a circle drawn on the ground. The experimenter tempted the child to leave the circle by hitting the balloon further from the circle on some trials.

Transparent box (Lab-TAB; Goldsmith et al., 1993; anger, sadness). The experimenter locked an appealing toy in a clear plastic box and left the child with an incorrect set of keys to open the lock and play with the toy. After three minutes, the experimenter returned with the correct set of keys and explained that she accidentally gave the child the wrong set of keys. The child was then allowed to open the box and play with the toy.

Simon says (4-7 years; Strommen, 1973; EC). This task was specifically designed to assess EC. The experimenter first had the child practice ten exercises (e.g., touch the floor) with her. The experimenter then told the child that in the game she will do all of the exercises and when she says, "Simon says" they should do them with her and when the experimenter does not say, "Simon says" they not do the exercises. After two practice trials, the experimenter completed two trials of all 10 exercises, regardless of child performance. A response was considered correct if the child make the correct action (or inaction) immediately or self-corrected without prompting.

Tell a story (Durbin et al., 2007; fear). The main experimenter told the child she would like to know how good they were at telling stories. The experimenter handed the child a picture book and told the child their job was to tell a story from the pictures. The experimenter explained that the second experimenter is an expert at stories and she is going to listen to the story. At the end of the story, the main experimenter asked the second experimenter to give her a grade on the child's story.

Pop-up snakes (Lab-TAB; Goldsmith et al., 1993; anticipatory PE, happiness, surprise). The experimenter showed the child what looked to be a can of potato chips, but instead contained coiled spring snakes. The experimenter demonstrated the trick and encouraged the child play the trick on their parent. The parent was not present for the first half of the task.

Walk-a-line-slowly (Kochanska et al., 1996; EC). The experimenter demonstrated how to walk on a line (12 feet in length) on the floor and asked the child to walk on the line. The experimenter then asked the child to walk down the line as slowly as they could, then as quickly as they could, and then as slowly as they could again. The experimenter then asked the child to walk as slowly as they could on a small balance beam resting on the floor.

Box empty (Lab-TAB; Goldsmith et al., 1993; anticipatory PE, anger, sadness). The experimenter gave the child a gift-wrapped empty box under the pretense that an appealing gift was inside. The child was left alone for 2.5 minutes to discover that the box was empty. The experimenter returned with two small toys for the child to take home, explaining that she accidentally forgot to put the toys inside the box. The parent was not present for this task.

Attentional Control Tasks

A subset of participants (n = 158) was administered additional measures of attentional control (described below). These tasks were completed in between the 16 laboratory tasks described above. Only tasks for which age-appropriate norms exist were administered to each child, such that participants of different ages received different numbers of tasks.

Digit span (ages 6-7; Wechsler, 2003). The child was asked to repeat lists of numbers read to them by the experimenter. The child was then asked to repeat lists of numbers backward read to them by the experimenter.

Hand game (ages 3-5; Hughes, 1998). The experimenter first demonstrated how to make a fist and point an index finger and asked the child to repeat both shapes with their hand. The experimenter then instructed the child to make a fist when the experimenter pointed her finger and to point their finger when the experimenter made a fist. The experimenter repeated these instructions each trial until the child made six consecutive correct responses (or until 15 trials were completed). Feedback was provided on each trial. A response was considered correct if the child made the correct hand action immediately or self-corrected without prompting.

Day/Night (ages 3-7; Gerstadt, Hong, & Diamond, 1994). The experimenter showed the child a black card depicting a moon and stars and said, “When you see this card, I want you to say the word ‘day’” and asked the child to repeat the word, ‘day.’ The experimenter then showed the child a white card with a yellow sun and said, “When you see this card, I want you to say the word ‘night’” and asked the child to repeat the word, “night.” The experimenter presented the cards one at a time, without providing feedback, for a total of 16 trials.

Letter-number sequencing (ages 6-7; Wechsler, 2003). The experimenter informed the child that she would say a group of numbers and letters and would like the child to tell her the numbers first, in order, starting with the lowest number and then the letters in alphabetical order. After two practice trials, the experimenter discontinued the test when the child erred on all three trials on one item.

Experimenter Rating of Children’s Temperament

Following the laboratory visit, the primary experimenter used the Child Behavior Scale (CBS; Gagne, Van Hulle, Aksan, Essex, & Goldsmith, 2011) to rate the child’s behavior during the visit on 24 different items: overall positive affect, overall negative affect, energy, adaptation to change in test materials, interest in test materials and stimuli, initiative with tasks, exploration of objects, attention to tasks, persistence in attempting to complete tasks, enthusiasm towards tasks, fear, frustration with inability to complete tasks, social engagement with child tester, social engagement with parent, cooperation with child tester, cooperation with parent, hyperactivity, shyness, prone to anger/irritability, prone to sadness, contentment, exuberance, anticipatory positive affect, and impulsivity. Each item was rated on a five-point Likert scale: 1 = behavior rarely or never exhibited; 2 = slight or ambiguous signs of the behavior; 3 = unambiguous tendency toward behavior; 4 = behavior exhibited to a typical degree; 5 = behavior exhibited to a high degree. In making these ratings, the experimenter considered not only the child's behavior during each structured task, but also all other behavior observed during the course of the visit (i.e., upon arrival to the lab, during free play that occurred in between tasks, and prior to leaving the lab). The experimenter made each rating immediately following the laboratory assessment. These experimenter ratings were examined in a previous investigation, which revealed a three-factor structure of child temperament, PE, NE, and EC (Vroman et al., 2014).

Objective Rating of Children's Temperamental Behavior

Each of the 16 lab tasks described above was coded using a global coding system validated in previous studies examining child temperament (Durbin, 2010; Durbin et al., 2007; Durbin, Klein, Hayden, Buckley, & Moerk, 2005). Coders were trained graduate and undergraduate students. Coders met weekly for reliability meetings. Coders completed global ratings of the child's behavior to index the child's engagement in the task, activity level, anticipatory positive affect, passivity vs. initiative, sociability, compliance, attentional control, and behavioral control vs. impulsivity. Each of these behaviors were rated on a four-point Likert scale (0 = low, 1 = moderate, 2 = moderate-to-high, and 3 = very high). Each behavior was assigned a single rating (0-3) based on all behaviors observed during the full length of the lab task video. Interest/engagement ratings were based on the child's degree of attentiveness and persistence to the task. Activity level ratings were based on the child's manipulation of objects, overall movement around the room, and vigor in manipulating stimuli presented during the episode. Anticipatory PE was based on the child's positive behavioral and emotional response in anticipation of a positive event. Initiative ratings were based on the child's degree of passivity or assertiveness in interactions with the experimenter or parent. Sociability ratings were based on the child's interest in and pursuit of social interaction with the experimenter or parent. Compliance ratings were based on the severity of the child's deliberate unwillingness to comply with the experimenter's or parent's suggestions or commands. Attentional control ratings were based on the child's ability to effectively allocate their attention in a flexible manner. Behavioral control vs. impulsivity ratings were based on the child's tendency towards impatience and impulsivity, in contrast to planful and adaptive regulation of behavior. Cronbach's alphas were as follows: interest (.76), activity (.88), initiative (.92), sociability (.91), attentional control (.71), and impulsivity (.84). Intraclass correlation coefficients (two-way random, absolute agreement; Shrout & Fleiss, 1979) for aggregates of these traits (aggregated across all 16 tasks) were as follows: interest (.68), activity (.89), initiative (.84), sociability (.89), attentional control (.60), and impulsivity (.73).

Coders also calculated performance-based measures during EC specific lab tasks. For the Snack Delay task, coders recorded the number of times the child prompted the experimenter to ring the bell, the number of errors the child committed (eating the M&M before end of trial), the number of self-corrected errors, and the number of times each child touched the M&M before instructed to do so. During the Balloon Bop task, coders recorded the number of instances the child stepped outside of the circle. The total score (number correct) on the Simon Says task was recorded as well. On the Walk-a-Line Slowly task, coders recorded the following: length of time to walk the line during the first trial (baseline), length of time to walk the line slowly (slow trial 1), length of time to walk the line fast (fast trial), and the length of time to walk the line slowly the second trial (slow trial 2). From these measurements, coders calculated three indicators of

EC performance: 1) slow trial 1 minus baseline trial, 2) slow trial 2 minus fast trial, and 3) slow trial 1 minus slow trial 2.

Parent Assessment of Child Temperament

At the end of the lab visit, participating mothers and fathers were given a battery of questionnaires to complete and return by mail. The questionnaires include the Children's Behavior Questionnaire (CBQ; Rothbart et al., 2001), which was designed to measure temperament in children aged 3-7 years, and includes subscales tapping the higher-order dimensions of Surgency/Positive Emotionality, Negative Emotionality, and Effortful Control. The CBQ includes items such as, "Can lower his/her voice when asked to do so," "Often rushes into new situations," and "Acts shy around new people." In this sample, Cronbach's alphas for the three scales ranged from .89 (maternal report on EC) to .93 (maternal report on Surgency). The alphas for these scales are reported in Table 3. Seventy nine percent of mothers and 50% of fathers completed the CBQ.

Parents also completed the Child Behavior Checklist (CBCL; Achenbach, 1991), which was designed to measure emotional and behavioral problems in 1.5-5 and 6-18-year-olds. The CBCL includes items such as, "Angry moods," "Can't sit still, restless, or hyperactive," and "Withdrawn, doesn't get involved with others." Parents also were contacted six months following the lab visit to complete CBCL again. Data from the 6-month follow-up were used in analyses when available. Analyses (described below) were conducted on the internalizing, and externalizing indices, as well as on the attention problems and anxious/depressed scales. Cronbach's alphas ranged from .76 (maternal report on anxious/depressed) to .86 (maternal report on externalizing) at baseline and .73 (maternal report on anxious/depressed) to .88 (maternal report on externalizing) at 6-month follow-up. The alphas for each scale at baseline and at 6-month follow-up are reported in Table 4. Seventy nine percent of mothers and 50% of fathers completed the CBCL at baseline and 66% of mothers and 58% of fathers completed the CBCL at 6-month follow-up. Due to the low number of completed questionnaires by fathers, we report only analyses with maternal report.

CHAPTER 3

ANALYTIC STRATEGY

Structure of EC

Exploratory factor analyses. All exploratory factor analyses (EFA) were performed in SPSS version 21 using a principal axis factor analysis (PAF) with an Oblimin (oblique) rotation. First, an EFA was performed to examine the structure of child temperament as reported by maternal report on the CBQ to determine the subscales that load onto the EC factor. An initial EFA was also performed on experimenter ratings of child behavior during the lab visit (i.e., ratings on the CBS) to determine which items on the CBS load onto an EC factor. A series of EFAs were then performed to examine the structure of trait EC assessed via four discrete methods of assessment: parent report, experimenter ratings, global behavior ratings and performance measures of EC during lab tasks, and attentional control tasks.

Confirmatory factor analyses. Confirmatory factor analyses (CFA) were run in Mplus (Version 7.1; Muthén & Muthén, 2012). A series of CFAs were conducted on the EC factors revealed from the EFAs of each of the separate methods described in the previous section. The fit indices for all models tested for each method of assessment were evaluated according the guidelines outlined in Hu & Bentler (1999) (all indicating good model fit): CFI/TLI $\geq$ .95, standardized root mean square residual (SRMR) $\leq$ .08, and root-mean-square error of approximation (RMSEA) $\leq$ .06.

Bivariate correlations. Bivariate correlations between all emergent EC factors were conducted to look for the presence of convergent validity by examining the magnitude of the intercorrelations between the factor scores.

Association between EC and Psychopathology

Linear associations. Linear associations between trait EC and internalizing and externalizing behaviors (as indicated via maternal-report on the CBCL concurrently and at the 6-month follow-up) were examined in SPSS. The composite factor scores that emerged in the first set of analyses on the structure of trait EC were the independent variable. The CBCL scales (dependent variables) examined include: Externalizing Problems, Internalizing Problems, Attention Problems, and Anxious/Depressed Behavior. The Attention Problems and Anxious/Depressed Behavior scales were selected as they are lower-order dimensions of externalizing and internalizing that have the most empirical support for associations with EC (e.g., Oldehinkel, Hartmna, De Winter, Veenstra, & Ormel et al., 2004). For these analyses, hierarchical linear regressions were conducted, wherein child age and sex were entered in the first step, followed the EC measure in the second step.

Nonlinear associations. Nonlinear associations between trait EC and maternal report on the CBCL (concurrently and at the 6-month follow-up) were also examined. The same independent and dependent variables were examined in the nonlinear analyses as in the linear analyses described above. Hierarchical regression analyses were conducted wherein child age and sex were entered in the first step, the EC measure was entered in the second step, and the square of the EC measure in the third step.

CHAPTER 4

RESULTS

Structure of EC: Parent-Report

EFA on CBQ. We first performed an EFA to examine the structure of trait EC assessed via maternal reports on the CBQ. As stated previously, EFAs were performed only on maternal data due to insufficient sample size in paternal CBQ data. The EFAs were performed in SPSS using a principal axis factor analysis (PAF) with an Oblimin (oblique) rotation on the 16 subscales of the CBQ. We selected an oblique rotation, as we wished to allow the emergent factors to correlate, as common dimensions of temperamental differences in children are unlikely to be orthogonal to one another. The PAF factor criterion was evaluated against the following criteria: (a) eigenvalue > 1.00 rule (Kaiser-Guttman criterion), (b) scree test (Gorsuch, 1983), (c) the configuration accounted for a minimum of 50% of the total variance (Streiner, 1994), and (d) a minimum of three variables per factor were required to identify common factors (Anderson & Rubin, 1956; Comrey, 1988). Variables were considered meaningful when their factor loadings were greater than .40. Based on these criteria and classic parallel analysis, a three-factor structure of the CBQ fit the data best for maternal report, explaining 54.8% of the variance of maternal reported child traits. We also conducted a principal components analysis with a Varimax rotation to assess whether similar results were obtained with an orthogonal rotation, as was the case in the Rothbart et al. (2001) study. Here, a three-factor structure also fit the data best, explaining 54.8% of the variance in maternal-reported child traits. Thus, a three-factor solution was determined to fit the data best. See Table 5.

The three factors were named according to the items that loaded onto each factor. Factor 1 was defined by loadings of activity level, approach to novel stimuli, high intensity pleasure, impulsivity, smiling, and a negative factor loading on shyness. Factor 1 appeared to reflect a broad PE dimension encompassing its mood, motivation, and sociability elements. Factor 2 was defined by loadings of soothability and attentional shifting, as well as negative loadings on anger, discomfort, fear, and sadness. This factor therefore appeared to reflect NE. Finally, the last factor was defined by loadings of attentional focusing, inhibitory control, low intensity pleasure, perceptual sensitivity, and attentional shifting. Attentional shifting exhibited large loadings on this factor (.51), as well as the NE factor (.41); however, attentional shifting exhibited a higher factor loading on EC and was therefore determined to load best on this factor. Thus, the third factor related best to EC, including elements of adaptability, cognitive control, and low levels of behavior problems related to low EC.

Parceling. Given that the CBQ EC scale in our sample is comprised of 5 subscales, we were limited in the model structures we could test. We therefore also elected to parcel the data - a measurement technique of aggregating items where the aggregates are then used as indicators of latent constructs. This approach to data analysis was advantageous with our dataset, as models with parcels have fewer parameter estimates (Little, Rhemtulla, Gibson, & Schoemann, 2013), thus providing us the opportunity to examine higher-order models of EC. We utilized the balancing approach to parceling, whereby the item with the highest item-scale correlation is matched with the item with the lowest item-scale correlation in the first parcel. The second highest and second lowest items are paired in the second parcel and the third highest and third lowest are paired in the third parcel. This process is continued until all items have joined a parcel. The balancing approach is an attempt at reflecting the overall factor structure of the scale in each of the three parcels (Little et al., 2013).

EFAs on EC. We then performed an EFA on the original EC factor comprised of 5 subscales to explore the structure of this higher-order factor. The PAF factor criterion was evaluated against the following criteria: (a) eigenvalue > 1.00 rule (Kaiser-Guttman criterion), and (b) scree test (Gorsuch, 1983). Variables were considered meaningful when their factor loadings were greater than .40. Based on these criteria, a two-factor structure of the CBQ fit the data best, explaining 49.1% of the variance in maternal reported child EC. See Table 6. We also conducted a PAF with a Varimax rotation to assess whether similar results were obtained with an orthogonal rotation. Again, a two-factor structure fit the data best, explaining 49.1% of the variance in maternal ratings of child EC. However, examination of the factor loadings revealed the loadings on factor 1 were high (ranging from .50-.95), with the exception of the perceptual sensitivity factor loading, which was .22. The factor loadings on the second factor were low-to-moderate (.08-.52), with the exception of the perceptual sensitivity factor loading (.72). The results of classic parallel analysis indicated a one-factor solution, rather than a two-factor model, fit the data best. We then ran an EFA constraining a one-factor solution; the factor loadings ranged from .45-.87, with one lower loading of .33 for perceptual sensitivity. However, this model only accounted for 36.9% of the variance. See Table 7. We ran second EFA again constraining the model to fit a one-factor solution excluding the perceptual sensitivity subscale, as this factor appeared to load separately from the remaining four factors, suggesting this factor may not be indicative of EC. This model accounted for 44% of the variance in maternal ratings of child EC and the factor loadings ranged from .48-.93. A one-factor solution was determined to fit the data best. See Table 8. As the perceptual sensitivity scale appeared to load on its own factor, we opted to remove this scale form the EC factor for all remaining analyses with maternal reported EC.

We then conducted a series of EFAs on the parceled EC data, which was comprised of a total of 15 parcels (three parcels per EC subscale). A PAF with an oblimin (and one with a varimax) rotation indicated a 4-factor solution fit the data best and explained 50.4% of the variance in maternal ratings of child EC. See Table 9. Here, the perceptual sensitivity parcels loaded onto one factor, the low intensity pleasure parcels loaded onto another factor, and there were significant cross loadings between the two remaining factors for the inhibitory control, attentional shifting, and attentional focusing parcels. The results from classic parallel analysis, however, indicated a two-factor solution was best. When the data was constrained to fit a 2-factor solution, the factor loadings on the first factor ranged from .30-.76, with low loadings on the perceptual sensitivity parcels (.02-.19). The factor loadings on the second factor were generally suppressed, ranging from -.03-.36, with the exception of moderate factor loadings on the low intensity pleasure parcels (.39-.46) and high loadings on the perceptual sensitivity parcels (.69-.82). When the three perceptual sensitivity parcels were excluded from the analysis, a three-factor solution fit the data best, explaining 46.8% of the variance in maternal reported child EC. See Table 10. The first factor was defined by loadings for the inhibitory control and attentional focusing parcels. The second factor was defined primarily by loadings for the attentional shifting parcels and the third factor was defined primarily by loadings for the low intensity pleasure parcels; however, there were several cross loadings on the second and third factors. When the EC parcels were constrained to fit a two-factor structure, the model explained 39.1% of the variance in maternal reported child EC. See Table 11. The first factor was primarily defined by loadings on the inhibitory control parcels, attentional focusing parcels, and the low intensity pleasure parcels. The second factor was defined primarily by loadings of the attentional shifting parcels. Lastly, when the EC parcels were constrained to fit a one-factor structure, the model explained 31.0% of the variance in maternal reported child EC. The factor loadings ranged from .35-.74.

In summary, the results of the EFAs indicate the factor structure of the CBQ is complex and the subscales do not easily map onto a given factor structure. While the inhibitory control, attentional shifting, attentional focusing, and low intensity pleasure subscales often tended to load on separate factors, high cross loadings were observed between each of the subscales for all models tested. The perceptual sensitivity subscale did not load onto a factor with any of the other four EC subscales. Overall, the results suggest that EC is multidimensional construct comprised of unique but related factors and that perceptual sensitivity is a less central component of EC than the other scales included on the CBQ.

CFAs on EC. Next, we conducted a series of CFAs based on the results of the previously reported EFAs. See Table 12 for the fit indices for each EC model tested. We first estimated a unidimensional model with the 15 EC parcels. The model demonstrated poor model fit: $\chi^2_{(90)} = 491.23$ ($p < .01$), AIC = 8977.33, BIC = 9129.64, CFI = .61, TLI = .54, RMSEA = .14, RMSEA 90% CI [0.13, 0.16], SRMR = .12. We estimated a second unidimensional model excluding the perceptual sensitivity parcels. This model resulted in improved model: $\chi^2_{(54)} = 214.99$ ($p < .01$), AIC = 7164.85, BIC = 7286.70, CFI = .78, TLI = .73, RMSEA = .12, RMSEA 90% CI [0.10, 0.13], SRMR = .08.

We also fit multidimensional models of EC. For example, we fit a model in which the inhibitory control, attentional shifting, and attentional focusing parcels loaded onto factor 1, and perceptual sensitivity and low intensity pleasure parcels loaded onto factor 2. This model produced poor fit indices: $\chi^2_{(89)} = 356.42$ ($p < .01$), AIC = 8844.53, BIC = 9000.21, CFI = .74, TLI = .69, RMSEA = .12, RMSEA 90% CI [0.11, 0.13], SRMR = .12. All multidimensional models we conducted produced comparable, and relatively poor fit indices. We also intended to fit hierarchical models; however, these models were under-identified and we therefore could not test hierarchical structures of EC. Next, we estimated a correlated 5-factor model, which produced acceptable-to-good model fit indices: $\chi^2_{(80)} = 139.45$ ($p < .01$), AIC = 8645.55, BIC = 8831.70, CFI = .94, TLI = .93, RMSEA = .06, RMSEA 90% CI [0.04, 0.07], SRMR = .06. Correlations between the five EC factors ranged from -.001 - .60. Most factor intercorrelations were moderate. Correlations between the perceptual sensitivity factor and the other four factors were modest-to-moderate (-.01 - .38). Similarly, correlations between the low intensity pleasure factor and the remaining four factors were slightly more variable and ranged from modest-to-moderate (-.001 - .51). The attentional shifting factor also exhibited modest-to-moderate correlations with the other factors (-.06 - .42). Lastly, we tested a correlated four-factor model, excluding perceptual sensitivity, and this model exhibited good model fit: $\chi^2_{(48)} = 87.79$ ($p < .01$), AIC = 7049.66, BIC = 7191.81, CFI = .95, TLI = .93, RMSEA = .06, RMSEA 90% CI [0.04, 0.08], SRMR = .05. Of the models we examined, the correlated 4-factor model was the best fitting model. See Figure 1. Consistent with the results of the EFAs, the results suggest EC is comprised of unique, but correlated factors, and perceptual sensitivity does not appear to be a factor of EC.

Structure of EC: Experimenter Ratings

EFA on experimenter ratings. Next, we examined the structure of EC assessed via experimenter ratings of child temperament during a laboratory visit. We first performed a series of EFAs on all 24 experimenter ratings of child behavior in order to determine which items loaded onto the EC factor. We again selected an oblique rotation, as we wished to allow the emergent factors to correlate. The PAF factor criterion was evaluated against the following criteria: (a) eigenvalue > 1.00 rule (Kaiser-Guttman criterion), (b) scree test (Gorsuch, 1983), (c) the configuration accounted for a minimum of 50% of the total variance (Streiner, 1994), and (d) a minimum of three variables per factor were required to identify common factors (Anderson & Rubin, 1956; Comrey, 1988). Variables were considered meaningful when their factor loadings were greater than .40. Based on these criteria and classic parallel analysis, a three-factor structure fit the data best, explaining 51.3% of the variance in experimenter ratings of child behavior (see Table 13). We also conducted a PAF with a Varimax rotation to assess whether similar results were obtained with an orthogonal rotation. Here, a three-factor structure also fit the data best, explaining 51.3% of the variance in experimenter ratings of child behavior. When the data were constrained to fit a 2-factor structure, the model explained 43.8% of the variance in experimenter ratings of EC and resulted in many high cross loadings between the two factors. When the data were constrained to fit a 4-factor structure, the model accounted for 55.4% of the variance in experimenter ratings of EC, and resulted in many low factor loadings across the four factors. Thus, a three-factor solution was determined to result in the most parsimonious model while still accounting for over 50% of the total variance.

The three factors were named according to the items that loaded onto each factor. Factor 1 was defined by loadings of adaptation to change, interest in the test materials, attention to tasks, persistence in completing tasks, cooperation with the experimenter, cooperation with parent, contentment, and a negative loading on impulsivity; this factor appeared to reflect EC. Factor 2 was defined by loadings of overall positive affect, energy, initiative with tasks, exploration of objects, enthusiasm, social engagement with the experimenter, social engagement with the parent, hyperactivity, exuberance, anticipatory positive affect, and a negative loading on shyness. This factor appeared to reflect PE. The third factor was defined by loadings of overall negative affect, fear, anger, sadness, and frustration and appeared to reflect NE.

EFAs on EC. We performed a PAF on the EC factor extracted from the initial analysis on all 24 items of the experimenter ratings of child behavior to explore the structure of the items on this EC factor. The PAF factor criterion was evaluated against the following criteria: (a) eigenvalue > 1.00 rule (Kaiser-Guttman criterion), (b) scree test (Gorsuch, 1983), and (c) the configuration accounted for a minimum of 50% of the total variance (Streiner, 1994). Variables were considered meaningful when their factor loadings were greater than .40. Based on these criteria, a two-factor structure of the experimenter ratings fit the data best, explaining 60.0% of the variance (See Table 14). Loadings of adaptation to change, attention, persistence, cooperation with the experimenter and the parent, and a negative loading on impulsivity primarily defined the first factor. The second factor was primarily defined by loadings of child interest in the tasks and contentment. Notably, many moderate-to-high cross loadings were observed between the two factors. When the data were constrained to fit a one-factor model, 51.3% of the variance in experimenter ratings of child EC was explained; factor loadings ranged from .40-.93 (see Table 15). When the data were constrained to fit a three-factor model, 63.3% of the variance was explained (see Table 16). Here, the first factor was defined primarily by factor loadings of adaptation to change, cooperation with the experimenter and parent, and a negative loading on impulsivity. The second factor was primarily defined by loadings of child interest in the test materials and contentment. The first factor was largely defined by loadings of attention to tasks, and persistence in attempting to complete tasks. This three-factor structure exhibited numerous moderate-to-high cross loadings among all three factors. We also conducted a PAF with a Varimax rotation to assess whether similar results were obtained with an orthogonal rotation. Again, a two-factor structure fit the data best, explaining 49.1% of the variance. In contrast to these results, classic parallel analysis indicated a one-factor model was best fitting. Close inspection of the factor loadings revealed that the two and three-factor solutions were not easily interpretable due to the numerous cross-loadings, thus making it difficult to readily identify the variables loading onto one factor or the other. Furthermore, a one-factor solution was determined to fit the data best.

CFAs on EC. Next, we conducted a series of CFAs based on the results of the previously reported EFAs. See Table 17 for the fit indices for each EC model tested. A one-factor model exhibited good model fit: $\chi^2_{(20)} = 112.43$ ($p < .01$), AIC = 5645.33, BIC = 5732.22, CFI = .93, TLI = .90, RMSEA = 0.13, RMSEA 90% CI [0.11, 0.15], SRMR = .06. We then fit multidimensional models of EC based on the factor loadings from the aforementioned EFAs. We first fit a multidimensional model wherein the interest in test materials, contentment, attention, and persistence experimenter ratings loaded onto factor 1, and the adaptation to change, cooperation with experimenter, cooperation with parent, and impulsivity experimenter ratings loaded onto the second factor. This model also exhibited good fit: $\chi^2_{(19)} = 87.28$ ($p < .01$), AIC = 5622.19, BIC = 5712.70, CFI = .95, TLI = .92, RMSEA = 0.11, RMSEA 90% CI [0.09, 0.14], SRMR = .05. We ran a second multidimensional model wherein the interest in test materials, contentment, and persistence experimenter ratings loaded onto factor 1, and the adaptation to change, cooperation with experimenter, cooperation with parent, impulsivity, and attention experimenter ratings loaded onto the second factor. This model produced comparable fit indices: $\chi^2_{(19)} = 97.62$ ($p < .01$), AIC = 5632.53, BIC = 5723.04, CFI = .94, TLI = .91, RMSEA = 0.12, RMSEA 90% CI [0.10, 0.15], SRMR = .05. Lastly, the final multidimensional model fit (interest in test materials, attention, persistence, and impulsivity experimenter ratings loaded onto factor 1, and the adaptation to change, cooperation with experimenter, cooperation with parent, and contentment experimenter ratings loaded onto the second factor) produced comparable fit indices to the first two multidimensional models examined: $\chi^2_{(19)} = 94.44$ ($p < .01$), AIC = 5629.35, BIC = 5719.86, CFI = .94, TLI = .91, RMSEA = 0.12, RMSEA 90% CI [0.10, 0.15], SRMR = .06. In summary, all unidimensional and multidimensional models examined produced acceptable-to-good fit indices. While the multidimensional models provided slightly improved model fit over the unidimensional model, the three multidimensional models looked highly similar to one another and the results did not clearly support one model over the others. Thus, a unidimensional model was determined to be the best fitting model of EC, as this was the most parsimonious model of EC. See Figure 2.

Structure of EC: Objective Coding

We performed a series of PAFs on the EC scales obtained from objective coding of child behavior during all 16 laboratory tasks. We ran three sets of analyses. First, we examined the structure of the global behavior ratings aggregated across all lab tasks (interest, activity, initiative, sociability, compliance, attentional control, impulsivity). Next, we examined the structure of the performance ratings recorded during the EC specific lab tasks (number of prompts each child gave to the experimenter during Snack Delay, number of self-corrected errors during Snack Delay, number of errors during Snack Delay, the number of times each child touched the M&M during Snack Delay, the number of instances the each child stepped outside of the circle in Balloon Bop, and the total score on Simon Says). The three performance codes obtained from the lab task Walk-a-Line Slowly (described above) were largely unrelated to the remaining performance measures. Two of the walk-a-line codes exhibited moderate correlations (-.35 - .40) with the number of times each child stepped outside of the circle during the Balloon

Bop task and the Simon Says total score. This suggests the walk-a-line slowly scores are likely tapping something different than the other performance measures and were therefore not included in these analyses. Lastly, we examined the structure of EC when the EC global codes and performance-based measures were included in the same analysis. Each PAF factor criterion was evaluated against the following criteria: (a) eigenvalue > 1.00 rule (Kaiser-Guttman criterion) and (b) scree test (Gorsuch, 1983). Variables were considered meaningful when their factor loadings were greater than .30.

EFAs on global behavior codes. First, we inspected the factor structure of all global behavior codes aggregated across the 16 lab tasks. Based on the aforementioned criteria a two-factor structure of the global behavior codes fit the data best, explaining 71.5% of the variance in child behavior. When the data were constrained to fit a one-factor model, 46.4% of the variance in child behavior was explained. When the data were constrained to fit a three-factor model, 76.9% of the variance was explained; however, this factor structure was difficult to interpret due to multiple moderate-to-high cross loadings across the three factors. We also conducted a PAF with a Varimax rotation to assess whether similar results were obtained with an orthogonal rotation. Again, a two-factor structure fit the data best, explaining 71.5% of the variance. Consistent with these results, classic parallel analysis indicated two-factor model was best fitting. Thus, a two-factor solution was determined to fit the data best. See Table 18. The first factor was defined by loadings of interest, activity, initiative, and sociability; this factor appeared to reflect PE. The second factor was defined by loadings of compliance, attentional control, and a negative loading on impulsivity. The second factor appeared to reflect EC and these three variables were used in subsequent analyses on the structure of EC.

EFAs on EC performance-based measures. Next, we examined the factor structure of the performance-based measures recorded during the EC-specific lab tasks. Based on the aforementioned criteria a two-factor structure of the EC performance-based measures fit the data best, explaining 26.5% of the variance. When the data were constrained to fit a one-factor model, 18.1% of the variance was explained. We also conducted a PAF with a Varimax rotation to assess whether similar results were obtained with an orthogonal rotation. Again, a two-factor structure fit the data best, explaining 26.5% of the variance. In contrast to these results, classic parallel analysis indicated one-factor model was best fitting. Close inspection of the factor loadings in the two-factor model indicated the first factor consisted of the number of errors made during Snack Delay, the number of self-corrected errors during Snack Delay, the number of times each child touched the M&M during Snack Delay, and the number of times each child stepped outside the circle during Balloon Bop. The second factor was comprised of two variables (the number of prompts given during Snack Delay and the Simon Says total score), and several modest cross-loadings were observed. Thus, the results appear indicative of a correlated two-factor structure. See Tables 19-20 for the results of the one- and two-factor models.

EFAs on EC global behavior codes and performance-based measures. We then examined the factor structure of the EC global behavior codes and performance-based measures together in the same model, as both measures were derived from objective coding of the lab tasks. Analyses were performed on standardized EC variables to account for differences in scaling between the global behavior codes and each performance measure. Based on the aforementioned criteria, a three-factor structure fit the data best, explaining 44.4% of the variance. Inspection of this factor structure revealed that the first factor was comprised of the three global behavior ratings (attentional control, compliance, and impulsivity) and the Simon

Says total score. The second factor was defined by loadings of the number of times each child stepped outside the circle during Balloon Bop, the errors on Snack Delay, the number of times each child touched the M&M during Snack Delay, and the number of self-corrected errors during Snack Delay. The third factor was only comprised of one factor loading (Number of prompts given in Snack Delay), with one cross loading greater than .30. We then constrained the data to fit a two-factor model, which accounted for 36.7% of the variance in EC global codes and performance-based ratings. This model resulted in a more interpretable model than the one-factor solution, as multiple variables loaded onto each factor and all factor loadings were moderate-to-large. Here, the three global behavior ratings (attentional control, compliance, and impulsivity) and the Simon Says total score again loaded onto the first factor. The second factor was comprised of the number of times each child stepped outside the circle during Balloon Bop, the errors on Snack Delay, the number of times each child touched the M&M during Snack Delay, and the number of self-corrected errors during Snack Delay, and the number of prompts given during Snack Delay. We also conducted a PAF with a Varimax rotation to assess whether similar results were obtained with an orthogonal rotation. Again, a two-factor structure fit the data best, explaining 36.7% of the variance. In contrast to these results, classic parallel analysis indicated one-factor model was best fitting. When the data was constrained to fit a one-factor model, only 28.6% of the variance in EC global and performance-based ratings and factor loadings ranged considerably (.22-.81). While the results of the three factor structures examined were not easily interpretable, the results appear most indicative of a correlated two-factor structure. See Tables 21-23 for the results of the three models examined.

CFAs on EC performance-based measures. We first tested a unidimensional structure of the EC performance-based measures wherein the number of self-corrected errors during Snack

Delay, number of errors made during Snack Delay, and number of times each child touched the M&M during Snack Delay, the number of prompts given during Snack Delay, the number of instances the each child stepped outside of the circle in Balloon Bop, and the total score on Simon Says loaded onto factor 1. This model exhibited good model fit: $\chi^2_{(9)} = 17.22$ ($p < .01$), AIC = 2401.74, BIC = 2461.20, CFI = .81, TLI = .68, RMSEA = 0.07, RMSEA 90% CI [0.01, 0.12], SRMR = .08. See Table 24. We were unable to fit the two-factor model that emerged from the aforementioned EFA, as the second factor in that model was comprised only of two performance ratings.

CFAs on EC global behavior codes and performance-based measures. We examined the factor structure of the EC global behavior codes and performance measures together in the same model. We first tested a unidimensional structure and this model exhibited good model fit: $\chi^2_{(27)} = 47.49$ ($p < .01$), AIC = 4314.24, BIC = 4411.30, CFI = .95, TLI = .93, RMSEA = 0.05, RMSEA 90% CI [0.03, 0.08], SRMR = .07. We then fit a two-factor model wherein the compliance, attentional control, and impulsivity global codes and the Simon Says total score variables loaded onto factor 1, and the number of self-corrected errors during Snack Delay, number of errors made during Snack Delay, and number of times each child touched the M&M during Snack Delay, the number of prompts given during Snack Delay, and the number of instances the each child stepped outside of the circle in Balloon Bop loaded onto factor 2. This model also exhibited good fit: $\chi^2_{(19)} = 46.05$ ($p < .01$), AIC = 4314.80, BIC = 4415.46, CFI = .95, TLI = .93, RMSEA = 0.05, RMSEA 90% CI [0.03, 0.08], SRMR = .07. The first factor in this model appears most reflective of behavioral control, whereas the second factor appears most indicative of impulsivity or low inhibitory control. See Table 25 for the fit indices of the one- and two-factor models examined. The results provided support for both a correlated two-factor model, as well as a unidimensional model of EC; however, we opted to support a unidimensional structure of EC, as this was the most parsimonious model of EC. See Figure 3.

Structure of EC: Attentional Control Measures

Due to the fact that only four attentional control measures were administered in this sample and the fact that not all four measures were administered to each child due to the unavailability of norms for children across our age group (3-7 years), we were limited in our ability to fit varying models of EC assessed via this method of assessment. Consequently, we report on bivariate correlations among the attentional control measures (see Table 26). Note that correlations are not reported between all attentional control measures as each task was administered only for those children for whom we had age-appropriate norms. Large-to-moderate significant correlations were observed between Day/Night and Letter-Number Sequencing (.53), Day/Night and Digit Span (.37), and Letter-Number Sequencing and Digit Span (.39). The Hand Game was modestly and insignificantly correlated with Day/Night (.16).

Structure of EC: Assessed via All EC Measures

EFAs on all EC measures. Lastly, we examined the factor structure of EC with EC measures across all methods of assessment in the same model. Analyses were performed on standardized EC variables to account for differences in scaling between each method of assessment. Here, we ran a PAF with an oblimin rotation examining the structure of the three EC global behavior codes (compliance, attentional control, and impulsivity), the four EC factors from the CBQ (inhibitory control, attentional shifting, attentional focusing, and low intensity pleasure), the experimenter ratings composite score (derived of the eight EC ratings), and the performance ratings composite (derived of the 6 EC performance measures). The PAF factor criterion was evaluated against the following criteria: (a) eigenvalue > 1.00 rule (Kaiser-

Guttman criterion), (b) scree test (Gorsuch, 1983), (c) the configuration accounted for a minimum of 50% of the total variance (Streiner, 1994), and (d) a minimum of three variables per factor were required to identify common factors (Anderson & Rubin, 1956; Comrey, 1988). Based on these criteria, a two-factor structure fit the data best, accounting for 51.6% of the variance. Here, the parent-reported EC factors loaded onto one factor and lab-derived measures of EC loaded together on the other factor; all loadings were > .40. See Table 27. The results of classic parallel analysis also suggested a two-factor structure was the best fitting model. When the data were constrained to fit a one-factor structure, the model accounted for 33.1% of the variance in EC, and examination of the factor loadings indicated they ranged considerably (.14-.81). See Table 28. When the data were constrained to fit a three-factor structure, the model explained 56.3% of the variance. See Table 29. Here, the first factor was defined by loadings on the three global behavior ratings (compliance, attentional control, impulsivity), the experimenter ratings composite, and the performance rating composite. The second factor was defined primarily by loadings of three of the EC factors from the CBQ. The third factor was not defined by any factor loadings, but did exhibit modest-to-moderate cross-loadings with the first two factors; thus, the three-factor solution was not easily interpretable due to many low loadings on the third factor. Therefore, the two-factor model was determined to be the best fitting model.

CFAs on all EC measures: Lastly, we tested the two-factor structure of EC assessed via all methods of assessment that emerged from the previously reported analyses, wherein the parent-reported EC factors loaded onto the first factor and the lab-derived measures of EC loaded together on the second factor. The two-factor structure resulted in good model fit indices: $\chi^2_{(26)} = 44.05$ ($p < .05$), AIC = 5288.04, BIC = 5389.41, CFI = .97, TLI = .96, RMSEA = 0.05, RMSEA 90% CI [0.02, 0.08], SRMR = .05. We then compared these results to a unidimensional factor structure. A one-factor model resulted in poor model fit indices: $\chi^2_{(27)} = 211.76$ ($p < .01$), AIC = 5453.75, BIC = 5551.50, CFI = .73, TLI = .64, RMSEA = 0.16, RMSEA 90% CI [0.14, 0.18], SRMR = .12. See Table 30 for the fit indices of the one- and two-factor models examined. Moreover, a correlated two-factor model was the best fitting model, indicating the parent-report measures of EC are relatively distinct from the laboratory-derived indices of EC. See Figure 4.

Bivariate Correlations between All Emergent EC Factors

Bivariate correlations were calculated between all EC variables and emergent factor scores (see Table 31). The four CBQ EC factors (inhibitory control, attentional shifting, attentional focusing, and low intensity pleasure) exhibited moderate-to-large intercorrelations (ranging from .23-.59). Similarly, the EC global behavior codes (compliance, attentional control, and impulsivity) demonstrated large intercorrelations, which ranged from .52-.67. The EC performance ratings exhibited modest-to-moderate intercorrelations, (ranging from -.01-.32). The attentional control measures were moderately-to-strongly intercorrelated with one another (ranging from .37-.53).

The data also were scrutinized for evidence of convergent validity (indicated by the magnitude of correlations across unique methods of assessing trait EC). Convergent validity was evidenced by moderate correlations between maternal reported EC and EC global behavior ratings derived from objective coding of child behavior during lab tasks, as well as modest correlations between maternal reported EC and experimenter ratings. Additional evidence for convergent validity was provided by the large intercorrelations between experimenter ratings and EC global ratings factor, as well as moderate intercorrelations with the Hand Game and Day/Night attentional control measures. Similarly, the EC performance factor also exhibited large correlations with EC global codes, as well as the experimenter ratings factor. Lastly, the

EC global codes exhibited moderate correlations with the Hand Game and Day/Night attentional control measures providing further evidence of convergent validity across unique methods of assessment. Not all emergent EC factors exhibited significant positive intercorrelations. For example, maternal reported EC was not significantly correlated with the EC performance ratings derived from objective coding, nor was maternal reported EC significantly correlated with any of the four attentional control measures. Lastly, no significant correlations were observed between the EC global codes and Digit Span and Letter-Number Sequencing, or between the experimenter ratings and Digit Span or Letter-Number Sequencing.

Concurrent Linear Associations

Hierarchical regression analyses were performed to test for concurrent linear associations between EC and child behavior assessed via maternal report on the CBCL. Analyses were conducted separately for each EC measure (i.e., maternal report, experimenter ratings, objective coding, attentional control). In each analysis, child age and sex were entered in the first step, followed by the EC measure in the second step.

EC via parent report. We first assessed the linear relation between maternal report of EC on the CBQ and externalizing behavior on the CBCL. Maternal reported EC significantly predicted child externalizing behavior problems beyond the effect of child age and sex (ΔR^2 = .20, $p < .001$). Next, to investigate which of the four EC factors were driving the relationship between EC and child externalizing problems, we simultaneously entered the four EC factors on the CBQ (inhibitory control, attentional shifting, attentional focusing, and low intensity pleasure) in the second step of the regression. The results indicated the EC factors inhibitory control (β = -.35, $p < .001$) and attentional shifting (β = -.17, $p < .05$) uniquely predicted maternal reported behavior on the externalizing problems scale, whereas attentional focusing (β = -.13, p = .09) and low intensity pleasure (β = .96, p = .34) were not uniquely predictive of child externalizing behaviors. See Tables 32-33.

We also examined the linear relation between maternal report of EC and internalizing behavior and EC significantly predicted child internalizing behavior problems beyond the effects of child age and sex (ΔR^2 = .02, p < .01). We further assessed which of the four EC factors were driving the relation between EC and child internalizing behavior by simultaneously entering the four EC factors on the CBQ in the second step of the regression model. Attentional shifting uniquely predicted maternal reported behavior on the internalizing problems scale (β = -.21, p < .01); inhibitory control (β = -.83, p = .41), low intensity pleasure (β = -.13, p = .90), and attentional focusing (β = .95, p = .34) did not significantly predict child internalizing behaviors. See Tables 34-35. The results indicate that parent reported EC is predictive of both internalizing and externalizing behaviors. Inhibitory control appears to be most implicated in externalizing behavior problems, whereas attentional shifting appears to be implicated in both externalizing and internalizing problems.

EC also was predictive of maternal reported attention problems (ΔR^2 = .39, p < .001). Examination of the four EC factors indicated inhibitory control (β = -3.97, p < .001), attentional shifting (β = -5.18, p < .001), and attentional focusing (β = -4.80, p < .001) uniquely predicted maternal reported behavior on the attention problems scale, whereas low intensity pleasure did not (β = 1.36, p = .18). See Tables 36-37.

Lastly, we investigated the association between EC and maternal reported child anxious/depressed behavior. Again, EC predicted maternal reported anxious/depressed behavior (ΔR^2 = .14, p < .05). We further assessed this relationship by entering the four EC factors simultaneously into the second step of the model, and attentional shifting (β = -.18, p < .05) uniquely predicted maternal reported attention problems; however, inhibitory control (β = -.09, p = .35), low intensity pleasure (β = .70, p = .50), and attentional focusing (β = .00, p = 1.00) were not uniquely predictive of child anxious/depressed behavior. See Tables 38-39. Overall, attentional shifting was consistently implicated in both internalizing and externalizing behavior problems, whereas inhibitory control tended to be most implicated in externalizing behavior problems. Low intensity pleasure never drove the association between EC and maternal reported internalizing and externalizing problems.

EC via experimenter ratings. Next, we assessed the linear relation between experimenter ratings of EC and maternal reported behavior on the CBCL. Experimenter ratings of EC predicted maternal reported externalizing behavior problems beyond the effects of child age and sex (ΔR^2 = .04, p < .01). Additionally, experimenter ratings were predictive of maternal reported attention problems (ΔR^2 = .04, p < .01). Experimenter ratings of EC did not significantly predict internalizing behavior problems on the CBCL (ΔR^2 = .00, p = .72), nor did they predict anxious/depressed behavior (ΔR^2 = .00, p = .85). See Tables 40-43.

EC via objective coding. We examined the linear relation between objective coding of child EC (i.e., the EC global and performance ratings derived from the EC specific lab tasks) and maternal reported externalizing, internalizing, attention, and anxious/depressed behavior on the CBCL. We first examined the linear relation between the EC performance rating composite and externalizing behavior; however, this analysis was not significant (ΔR^2 = .00, p = .72). Performance ratings of EC were also not predictive of internalizing problems (ΔR^2 = .00, p = .31), nor were they predictive of child attention problems (ΔR^2 = .01, p = .20) or anxious/depressed problems (ΔR^2 = .01, p = .16). See Tables 44-47.

EC via attentional control. We investigated the association between EC assessed via attentional control measures administered during the lab visit (i.e., Hand Game, Day/Night, Digit Span, Letter-Number Sequencing) and maternal reported behavior on the CBCL. We first separately assessed the linear relation between each of the attentional control measures and externalizing behavior. None of the analyses produced significant results: Hand Game (ΔR^2 = .00); Day/Night (ΔR^2 = .00), Digit Span (ΔR^2 = .01), and Letter-Number Sequencing (ΔR^2 = .01), all p's > .05. We also investigated the relation between the attentional control measures and internalizing problems, and again, none of the analyses resulted in significant effects: Hand Game (ΔR^2 = .02); Day/Night (ΔR^2 = .01), Digit Span (ΔR^2 = .00), and Letter-Number Sequencing (ΔR^2 = .05), all p's > .05. Next, we examined the relationship between all attentional control measures and maternal reported attention problems. No analyses were significant: Hand Game (ΔR^2 = .00), Day/Night (ΔR^2 = .00), Digit Span (ΔR^2 = .00), and Letter-Number Sequencing (ΔR^2 = .02), all p's > .05. Lastly, we investigated the linear relation between each attentional control measure and maternal reported anxious/depressed behavior, and again, no analyses produced significant effects: Hand Game (ΔR^2 = .01), Day/Night (ΔR^2 = .01), Digit Span (ΔR^2 = .01), and Letter-Number Sequencing (ΔR^2 = .02), all p's > .05.

Prospective Linear Associations

Hierarchical regression analyses were performed to test for prospective linear associations between EC and child behavior assessed via maternal report on the CBCL at 6-month follow-up. Analyses were conducted separately for each EC measure (i.e., maternal report, experimenter ratings, objective coding, attentional control). In each analysis, child age, sex, and the baseline CBCL scores for the scale of interest were entered in the first step, followed by the EC measure in the second step.

EC via parent report. We first assessed the prospective linear relation between maternal report of EC and externalizing behavior on the CBCL, and EC significantly predicted externalizing behavior problems beyond that of child age, sex, and baseline externalizing CBCL scores ($\Delta R^2 = .05$, $p < .001$). Next, we investigated which of the four EC factors were driving the relation between EC and maternal reported child externalizing problems by simultaneously entering the four EC factors in the second step of the regression model. The EC factor and attentional shifting ($\beta = -.16$, $p < .05$) uniquely predicted maternal reported behavior on the externalizing problems; inhibitory control ($\beta = -.12$, $p = .20$), low intensity pleasure ($\beta = -.08$, $p = .29$) and attentional focusing ($\beta = .02$, $p = .82$) were not uniquely predictive of child externalizing behaviors. See Tables 48-49.

Next, we examined the prospective linear relation between maternal report of EC and internalizing behavior on the CBCL and EC did predict internalizing behavior as well ($\Delta R^2 = .02$, $p < .05$) above and beyond the effects of child age, sex, and baseline internalizing CBCL scores. Here, only the EC factor attentional shifting was uniquely predictive of maternal reported behavior on the internalizing problems scale ($\beta = -.21$, $p < .01$). Inhibitory control ($\beta = .06$, $p = .53$), low intensity pleasure ($\beta = -.10$, $p = .20$), and attentional focusing ($\beta = .01$, $p = .89$) were not uniquely predictive of child internalizing behaviors. See Tables 50-51.

Maternal reported EC also significantly predicted child attention problems on the CBCL at the 6-month follow-up beyond the effects of age, sex, and baseline attention problems scores on the CBCL ($\Delta R^2 = .03$, $p < .01$). We again examined which of the four EC factors were driving the association between EC and maternal reported child attention problems by simultaneously entering the four EC factors into the second step of the regression model. The EC factor inhibitory control ($\beta = -.18$, $p < .05$) uniquely predicted maternal reported attention problems; attentional shifting (β = -.07, p = .33), low intensity pleasure (β = -.00, p = .96), and attentional focusing (β = -.04, p = .65) were not uniquely predictive of child attention problems. See Tables 52-53.

Lastly, we investigated the prospective linear association between EC and maternal reported child anxious/depressed behavior. This model was not significant, indicating maternal reported EC was not predictive of child anxious/depressed behavior at the 6-month follow-up (ΔR^2 = .00, p = .58). See Tables 54-55.

EC via experimenter ratings. We examined the prospective linear relation between experimenter ratings of EC and externalizing behavior on the CBCL at the 6-month follow-up. Experimenter ratings of EC were not predictive of maternal reported externalizing behavior problems at the 6-month follow-up beyond the effects of child age, sex, and baseline externalizing behavior on the CBCL (ΔR^2 = .00, p = .29). Experimenter ratings of EC were also not significantly predictive of child internalizing behavior on the CBCL beyond the effects of age, sex, and baseline CBCL internalizing scores (ΔR^2 = .00, p = .46), nor were they predictive of maternal reported attention problems (ΔR^2 = .01, p = .10), or anxious/depressed behavior (ΔR^2 = .02, p = .90). See Tables 56-59.

EC via objective coding. We then investigated the prospective linear relation between EC lab measures (EC global and performance measures) derived from objective coding of the lab tasks and maternal reported behavior on the CBCL at the 6-month follow-up. Objective coding measures of EC were not predictive of externalizing behavior at 6-month follow-up beyond the effects of age, sex, and baseline externalizing behavior on the CBCL (ΔR^2 = .01, p = .17). Similarly, EC objective coding measures failed to predict internalizing behavior at follow-up (ΔR^2 = .00, p = .48). EC objective coding measures also were not predictive of maternal reported attention problems ($\Delta R^2 = .01$, $p = .13$) or anxious/depressed behavior ($\Delta R^2 = .00$, $p = .35$). See Tables 60-63.

EC via attentional control. We investigated the association between EC assessed via attentional control measures administered during the lab visit (i.e., Hand Game, Day/Night, Digit Span, Letter-Number Sequencing) and maternal reported behavior on the CBCL at the 6-month follow-up. We first separately assessed the linear relation between each of the attentional control measures and externalizing behavior. None of the analyses produced significant results: Hand Game ($\Delta R^2 = .00$); Day/Night ($\Delta R^2 = .01$), Digit Span ($\Delta R^2 = .01$), and Letter-Number Sequencing ($\Delta R^2 = .01$), all p's > .05. We also investigated the relation between the attentional control measures and internalizing behavior, and again, none of the analyses resulted in significant effects: Hand Game ($\Delta R^2 = .01$); Day/Night ($\Delta R^2 = .02$), Digit Span ($\Delta R^2 = .06$), and Letter-Number Sequencing ($\Delta R^2 = .05$), all p's > .05. Next, we examined the relationship between all attentional control measures and maternal reported attention problems. No analyses were significant: Hand Game ($\Delta R^2 = .01$), Day/Night ($\Delta R^2 = .00$), Digit Span ($\Delta R^2 = .00$), and Letter-Number Sequencing ($\Delta R^2 = .02$), all p's > .05. Lastly, we investigated the linear relation between each attentional control measure and maternal reported anxious/depressed behavior, and Digit Span ($\Delta R^2 = .06$, $p < .05$) and Letter-Number Sequencing ($\Delta R^2 = .06$, $p < .05$) were predictive of anxious/depressed behavior at the 6-month follow-up beyond the effects of child age, sex, and baseline anxious/depressed CBCL scores (see Tables 64-65). The Hand Game ($\Delta R^2 = .00$) and Day/Night ($\Delta R^2 = .02$) analyses were not significant, both p's > .05.

Concurrent Nonlinear Associations

Hierarchical regression analyses were performed to test for concurrent nonlinear associations between EC and child behaviors as indicated by maternal report on the CBCL.

Analyses were conducted separately for each EC measure. In each analysis, child age and sex were entered in the first step, the EC measure (i.e., maternal report, attentional control, experimenter ratings, objective coding) in the second step, and the square of the EC measure in the third step.

EC via parent report. We investigated the nonlinear association between maternal reported EC on the CBQ and externalizing behavior on the CBCL. A nonlinear effect was not detected ($\Delta R^2 = .00$, $p = .52$). Similarly, a nonlinear effect was not detected between EC and internalizing behavior ($\Delta R^2 = .00$, $p = .57$), nor was a nonlinear effect observed between EC and maternal reported attention problems ($\Delta R^2 = .01$, $p = .06$) or anxious/depressed behavior ($\Delta R^2 = .00$, $p = .93$) on the CBCL. See Tables 66-69.

EC via experimenter ratings. Next, we investigated the nonlinear association between experimenter ratings of EC and externalizing behavior on the CBCL. A nonlinear effect was not detected ($\Delta R^2 = .01$, $p = .16$). Similarly, a nonlinear effect was not detected between EC and internalizing behavior ($\Delta R^2 = .00$, $p = .88$), nor was a nonlinear effect observed between EC and maternal reported attention problems ($\Delta R^2 = .01$, $p = .08$) or anxious/depressed behavior ($\Delta R^2 = .00$, $p = .56$) on the CBCL. See Tables 70-73.

EC via objective coding. We also investigated the nonlinear association between global and performance ratings of EC derived from objective coding of lab tasks and externalizing behavior on the CBCL. A nonlinear effect was not detected ($\Delta R^2 = .00$, $p = .63$). A nonlinear effect also was not detected between EC and internalizing behavior ($\Delta R^2 = .00$, $p = .59$), nor was a nonlinear effect observed between EC and maternal reported attention problems ($\Delta R^2 = .00$, $p = .64$) or anxious/depressed behavior ($\Delta R^2 = .00$, $p = .82$) on the CBCL. See Tables 74-77.

EC via attentional control. Lastly, we investigated the concurrent nonlinear association between EC assessed via attentional control measures administered during the lab visit (i.e., Hand Game, Day/Night, Digit Span, Letter-Number Sequencing) and maternal reported behavior on the CBCL. We first separately assessed the nonlinear relation between each of the attentional control measures and externalizing behavior. None of the analyses produced significant results: Hand Game ($\Delta R^2 = .03$), Day/Night ($\Delta R^2 = .00$), Digit Span ($\Delta R^2 = .00$), and Letter-Number Sequencing ($\Delta R^2 = .00$), all p's > .05. We also investigated the relation between the attentional control measures and internalizing behavior, and Letter-Number Sequencing was predictive of maternal reported internalizing behavior ($\Delta R^2 = .09$, $p < .05$) (see Table 78). None of the other analyses resulted in significant effects: Hand Game ($\Delta R^2 = .01$); Day/Night ($\Delta R^2 = .00$), Digit Span ($\Delta R^2 = .02$), all p's > .05. Next, we examined the relationship between all attentional control measures and maternal reported attention problems, and the Hand Game ($\Delta R^2 = .05$, $p < .05$) was predictive of maternal attention problems (see Table 79). No other analyses were significant: Day/Night ($\Delta R^2 = .00$), Digit Span ($\Delta R^2 = .00$), and Letter-Number Sequencing ($\Delta R^2 = .02$), all p's > .05. Lastly, we investigated the nonlinear relation between each attentional control measure and maternal reported anxious/depressed behavior, and Letter-Number Sequencing ($\Delta R^2 = .10$, $p < .05$) was predictive of maternal reported anxious/depressed behavior (see Table 80). No other analyses were significant: Hand Game ($\Delta R^2 = .03$) and Day/Night ($\Delta R^2 = .00$), Digit Span ($\Delta R^2 = .05$), all p's > .05.

Prospective Nonlinear Associations

Hierarchical regression analyses were performed to test for prospective nonlinear associations between EC and child behaviors as reported on the CBCL at the 6-month follow-up. Analyses were conducted separately for each EC measure. In each analysis, child age, sex, and the baseline CBCL score of the variable of interest were entered in the first step, the EC measure (i.e., maternal report, attentional control, experimenter ratings, objective coding) in the second step, and the square of the EC measure in the third step.

EC via parent report. We investigated the prospective nonlinear association between maternal reported EC on the CBQ and externalizing behavior on the CBCL at the 6-month follow-up. A nonlinear effect was not detected ($\Delta R^2 = .00$, $p = .95$). Similarly, a nonlinear effect was not detected between EC and internalizing behavior ($\Delta R^2 = .00$, $p = .83$), nor was a nonlinear effect observed between EC and maternal reported attention problems ($\Delta R^2 = .00$, $p = .53$) or anxious/depressed behavior ($\Delta R^2 = .00$, $p = .44$) on the CBCL at the 6-month follow-up. See Tables 81-84.

EC via experimenter ratings. Next, we investigated the nonlinear association between experimenter ratings of EC and externalizing behavior on the CBCL. A nonlinear effect was not detected ($\Delta R^2 = .00$, $p = .95$). Similarly, a nonlinear effect was not detected between EC and internalizing behavior ($\Delta R^2 = .00$, $p = .97$), nor was a nonlinear effect observed between EC and maternal reported attention problems ($\Delta R^2 = .00$, $p = .30$) or anxious/depressed behavior ($\Delta R^2 = .00$, $p = .91$) on the CBCL at the 6-month follow-up. See Tables 85-88.

EC via objective coding. We also investigated the prospective nonlinear association between global and performance ratings of EC derived from objective coding of lab tasks and externalizing behavior on the CBCL. A nonlinear effect was not detected ($\Delta R^2 = .00$, $p = .55$). A nonlinear effect also was not detected between EC and internalizing behavior ($\Delta R^2 = .00$, $p = .61$), nor was a nonlinear effect observed between EC and maternal reported attention problems ($\Delta R^2 = .01$, $p = .27$) or anxious/depressed behavior ($\Delta R^2 = .00$, $p = .85$) on the CBCL at the 6-month follow-up. See Tables 89-92.

EC via attentional control. Lastly, we investigated the nonlinear association between EC assessed via attentional control measures administered during the lab visit (i.e., Hand Game, Day/Night, Digit Span, Letter-Number Sequencing) and maternal reported behavior on the CBCL at the 6-month follow-up. We first separately assessed the nonlinear relation between each of the attentional control measures and externalizing behavior. None of the analyses produced significant results: Hand Game (ΔR^2 = .01), Day/Night (ΔR^2 = .00), Digit Span (ΔR^2 = .01), and Letter-Number Sequencing (ΔR^2 = .00), all p's > .05. We also investigated the relation between the attentional control measures and internalizing behavior, and again, none of the analyses resulted in significant effects: Hand Game (ΔR^2 = .02), Day/Night (ΔR^2 = .01), Digit Span (ΔR^2 = .04), and Letter-Number Sequencing (ΔR^2 = .00), all p's > .05. Next, we examined the relationship between all attentional control measures and maternal reported attention problems. No analyses were significant: Hand Game (ΔR^2 = .01), Day/Night (ΔR^2 = .01), Digit Span (ΔR^2 = .00), and Letter-Number Sequencing (ΔR^2 = .01), all p's > .05. Lastly, we investigated the nonlinear relation between each attentional control measure and maternal reported anxious/depressed behavior and no analyses were significant: Hand Game (ΔR^2 = .02), Day/Night (ΔR^2 = .00), Digit Span (ΔR^2 = .00), and Letter-Number Sequencing (ΔR^2 = .01), all p's > .05.

CHAPTER 5

DISCUSSION

This study examined the factor structure of EC (assessed via four methods of assessment: parent report, experimenter ratings and objective coding of child behavior in response to lab tasks, and attentional control measures), as well as the concurrent and predictive linear and nonlinear associations between EC and two common dimensions of psychopathology (externalizing and internalizing symptoms) in early childhood. Understanding the structure of EC has significant methodological implications for researchers. It is critical that we understand the structure of EC in order to better assess this trait, as improved measurement precision will facilitate our understanding of the developmental course of EC, as well as our understanding of the associations between trait EC and psychopathology in childhood (Blair, Zelazo, & Greenberg, 2005).

Specific Aim 1: Structure of Trait EC

With regard to the first aim of the study (examining the structure of trait EC), we first investigated trait EC assessed via maternal report on the CBQ and determined a three-factor structure fit the data best consisting of PE, NE, and a clear EC factor. These results are consistent with results obtained from previous research on the CBQ (Ahadi et al., 1993; Casalin et al., 2012; Rothbart et al., 2001; Rothbart & Bates, 1998; Tellegen, 1985). The structure of the EC factor assessed via maternal report on the CBQ, however, was less clearly identified, as the EC subscales did not easily map onto a given factor structure. While the inhibitory control, attentional shifting, attentional focusing, and low intensity pleasure subscales often tended to load on separate factors, high cross loadings were observed between each of the subscales for all models tested. The perceptual sensitivity subscale did not load onto a factor with any of the other four EC subscales, suggesting this subscale was not indicative of EC. Of the several unidimensional and multidimensional models investigated, a correlated four-factor model (excluding the perceptual sensitivity subscale) provided the best fitting model. Overall, the results suggest that maternal reported EC is multidimensional construct comprised of unique but related factors, and perceptual sensitivity does not appear to be a factor of EC. The perceptual sensitivity subscale of the CBQ was designed to assess children's ability to detect low intensity stimuli from their surrounding environment and has been the subject of little-to-no empirical investigation. This subscale likely is not assessing the same aspects of child temperament as the inhibitory control, attentional shifting and focusing, and low intensity pleasure subscales. Our results are inconsistent with the results obtained in another investigation of the structure of EC assessed via parental report on the CBQ, which uncovered a unidimensional model of EC (Gusdorf et al., 2011). However, in this investigation, the one-factor model was not subjected to empirical investigation via CFA. Therefore it is still unclear whether the results of this investigation are consistent with the results on the structure of the EC reported herein.

Consistent with the methods employed to examine the parent ratings of child temperament, we next examined the structure of experimenter ratings of child behavior derived from observation of child behavior during lab tasks. While the unidimensional and multidimensional models of experimenter ratings of EC examined all resulted in similar model fit indices, a one-factor model of experimenter ratings was determined to the be the best fitting model, as this was the most parsimonious model of EC and the multidimensional models did not exhibit significant improvements in model fit. Similar results were obtained when we examined the structure of EC assessed via objective coding of child behavior during lab tasks. Here, the results supported both a correlated two-factor model, as well as a unidimensional model of EC.

We again opted to support a unidimensional structure of EC, as this was the most parsimonious model of EC. Our results are similar to a few studies that examined the structure of trait EC either via laboratory tasks or a combination of lab tasks and informant report (Allan & Lonigan, 2011; Sulik et al., 2010; Willoughby et al., 2012). Consistent with the results of this investigation, these studies also found support for unidimensional and multidimensional models of EC, but settled on a one-factor model, as none of the multidimensional models resulted in significant improvement in model fit.

We also had hoped to assess the structure of the attentional control neurocognitive measures administered during the lab visit, as neurocognitive measures are widely administered in the adult literature (e.g., Kamradt, Ullsperger, Nikolas, 2014; Miyake et al., 2000), but are relatively absent from the child literature. However, due to the fact that only four attentional control measures were administered in this sample, and the fact that not all four measures were administered to each child due to the unavailability of norms for children across our age group (3-7 years), we were limited in our ability to fit varying models of EC assessed via this method of assessment. Consequently, we examined bivariate correlations among the attentional control measures; overall, correlations between these measures were modest-to-moderate.

Lastly, we examined the factor structure of EC assessed via all methods of assessment (parent report, experimenter ratings and objective coding of child behavior in response to lab tasks, and attentional control measures). Here, a correlated two-factor model was the best fitting model (with a moderate intercorrelation between the two factors), indicating the parent-report measures of EC are relatively distinct from the laboratory-derived indices of EC. This is not surprising, given the modest-to-moderate correlations between maternal reported EC and global behavior ratings, as well as experimenter reports of EC. Additionally, maternal reported EC exhibited relatively few significant correlations with the EC performance measures derived from objective coding. Indeed, modest-to-moderate convergence between informant report and lab tasks has been documented in several investigations (e.g., Kochanska et al., 1996; Kochanska et al., 1997; Muris et al., 2008), implying acceptable-to-good convergence between methods of assessment both in the current investigation and other separate examinations of child traits. Both informant report and lab tasks have been criticized for their limitations, and these limitations likely contribute to the modest-to-moderate convergence between methods. For example, laboratory tasks have been criticized on the basis that these tasks are comprised of contrived scenarios and administered in novel settings, which is believed to weaken the ecological validity of this approach (e.g., Dhami et al., 2004; Majdandžić & Van Den Boom, 2007). Nonetheless, recent evidence indicates parents considered their child's behavior during lab tasks as highly typical of their child's behavior outside of the lab, indicating the ecological validity of child behavior elicited during lab tasks (Lo, Vroman, & Durbin, 2015). Additionally, there is evidence that parent report is biased by characteristics such as depression and anxiety (e.g., Chi & Hinshaw, 2002; Gartstein, Bridgett, Dishion, & Kaufman, 2009). Further work must be completed to discover the mechanisms underlying differences between informant report and lab derived measures of EC.

Specific Aim 2: Associations between EC and Psychopathology

Regarding specific aim two, we examined the association between EC assessed via each method of assessment and maternal reported externalizing and internalizing problems on the CBCL concurrently and at the 6-month follow-up. We first examined the linear relation between maternal reported EC on the CBQ and maternal reported child behavior on the CBCL. Consistent with our hypotheses, EC was predictive of both externalizing and internalizing behavior problems, as well as attention problems and anxious/depressed behavior. Overall, attentional shifting was consistently implicated in both internalizing and externalizing behavior problems, whereas inhibitory control tended to be most implicated in externalizing behavior problems. Our results are similar to other investigations in which attentional control was associated with anxiety symptoms in 9-17-year-old child and adolescents (Meesters et al., 2007), as well as internalizing and externalizing symptoms in middle childhood (Muris et al., 2008). Low intensity pleasure never drove the association between EC and maternal reported internalizing and externalizing problems, indicating this factor of EC is not predictive of child behavior problems. Maternal reported EC also was significantly predictive of externalizing, internalizing, and attention problems on the CBCL at the 6-month follow-up.

Similar to the results obtained via maternal reported EC, experimenter ratings of EC significantly predicted maternal reported externalizing behavior problems on the CBCL, as well as attention problems; however, no linear association was detected between EC and internalizing or anxious/depressed behavior. On the other hand, Digit Span and Letter-Number Sequencing were predictive of child anxious/depressed behavior on the CBCL; however, no other attentional control measures were predictive child behavior problems. In contrast to our hypotheses, objective coding of lab tasks and the attentional control measures were not predictive of maternal reported behavior problems on the CBCL.

Lastly, as little work has been devoted to examining nonlinear associations between trait EC and child behavior, we examined both concurrent and prospective nonlinear associations between EC and maternal reported child behavior problems on the CBCL. While no prospective nonlinear relations were significant, we did detect a few concurrent nonlinear associations between attentional control measures and child behavior problems; Letter-Number Sequencing was predictive of maternal reported internalizing behavior and anxious/depressed behavior, and the Hand Game was predictive of attention problems.

Our results are consistent with some preliminary evidence supporting a nonlinear relation between EC and positive psychological outcomes. For example, one longitudinal study examining EC and mother-reported total behavior problems on the CBCL from toddlerhood to early school age (Murray & Kochanska, 2002) and determined that children with low and high levels of EC, as assessed by lab tasks, were found to have the greatest number of problem behaviors, in contrast to children with moderate levels of EC. A second study also detected a nonlinear association between EC (assessed via lab tasks) and emotion regulation (assessed via lab tasks), such that moderate levels of EC were associated with high levels of emotion regulation (Carlson & Wang, 2007). Nonetheless, our results were overwhelming in support of a linear association between EC and child behavior, suggesting higher levels of EC are likely most protective against internalizing and externalizing problems in early childhood.

In summary, the results generally support a unidimensional structure of trait EC in young children, with modest-to-moderate convergent validity between parent report, experimenter ratings, objective coding of child behavior, and attentional control measures providing additional support for this model. Also, trait EC (across most methods of assessment) exhibited concurrent, as well as a few prospective predictive relations with maternal reported externalizing and internalizing behavior problems on the CBCL.

Contributions of the Current Study

The current study contributed to the existing literature in several ways. First, we explored the structure of trait EC via multiple methods of assessment (i.e., parent report, experimenter ratings, objective coding, and attentional control neurocognitive tasks), in contrast to relying on one method of assessment, as is often the case. We incorporated parent report of trait EC, the most heavily relied upon method for assessing child traits, as well as methods that have received far less attention in the literature. For example, laboratory approaches, as opposed to questionnaire methods, are more cumbersome to utilize, which prevents their broader use in the literature. However, behavioral ratings have several strengths, including providing a structured examination of and more direct means of quantifying individual differences in children's traits. Additionally, neurocognitive measures are widely administered in the adult literature on EF; however, neurocognitive measures of EC have received little-to-no attention in the child literature. As the convergence between different methods of assessing child EC is modest-to-moderate at best, continued investigation of the areas of convergence and divergence across methods is necessary to uncover the structure of trait EC. Additionally, much of the extant literature has examined only concurrent linear associations between trait EC (assessed via one method of assessment) and child behavior (e.g., Murray & Kochanska, 2002). This study built upon the existing literature by examining both linear and nonlinear associations between trait EC and child behavior concurrently and prospectively (at 6-month follow-up).

Clinical Implications

Continuing to illuminate the association between EC and psychopathology has significant implications for our ability to identify children who may be at risk for adverse behavioral and psychological outcomes. EC may serve a regulatory function in the experience and manifestation of emotion. Indeed, the role of EC in emotion regulation processes has been supported empirically; measures of EC and ER are interrelated in children (Carlson & Wang, 2007; Kieras et al., 2005), indicating that EC processes may facilitate the development of emotion regulation or perhaps that emotion regulation may be a subdomain of EC processes.

Children rated high in EC exhibit lower levels of negative emotionality, perhaps because those with high EC are better able to effectively manage their emotions and behavioral responses (Carlson & Wang, 2007). More indirect evidence is derived from the similarity in the developmental trajectories of EC and emotion regulation across infancy and into early childhood, as both improves with age in early childhood (Carlson & Wang, 2007; Dennis et al., 2007). This implies that EC may be implicated in the development of psychopathology, namely internalizing and externalizing symptoms, as these disorders are thought to involve the capacity to effectively regulate affective states (e.g., Cicchetti, Ackerman, & Izard, 1995), as well as behavior. The nature of the association between EC and psychopathology is likely complex and the specific nature of the relationship has yet to be precisely delineated. Moreover, the results of the current study indicated EC exhibits concurrent (as well as a few prospective) predictive relations with maternal reported externalizing and internalizing behavior problems on the CBCL.

Limitations and Directions for Future Research

Future research should strive to build on the limitations of the current study. First, we were only able to collect measures of child EC at one time point and therefore unable to explore how the structure of trait EC may change with age. Additionally, less is known about the nature of temperament in younger children and infants relative to adolescence and adulthood. While a few longitudinal examinations of trait EC have been conducted in early childhood (e.g., Kochanska et al., 1996), little work has been conducted in this area. Longitudinal examinations of EC from early childhood through adolescence would address this current gap in the literature considerably. Additionally, although factor analysis is useful for summarizing the covariance in measured variables, the accuracy of the recovered structure depends upon the nature of those variables, the sample in which they were measured, and the clarity of the structure relative to other alternatives. Furthermore, the existence of a particular structure does not reveal the underlying developmental processes that produced the observed covariance structure. Evidence of differential influences upon or outcomes related to trait EC generated by longitudinal studies would provide important evidence for the validity of structural analyses such as those we report. Lastly, our assessment of child behavior problems derived from the CBCL were parent reported, as was one of our measure of trait EC (i.e., maternal report on the CBQ), potentially inflating the associations between parent-assessed EC and behavioral problems relative to measures of EC assessed via alternative methods of assessment.

APPENDICES

APPENDIX A: TABLES

Table 1

Demographics

Variable		*M* (*SD*) or %
Age (years)		4.5 (1.4)
Gender	Male	51%
	Female	49%
Ethnicity	Caucasian/White	80%
	Latino/Hispanic	9.4%
	African American/Black	8.4%
	Bi or Multiracial	5.6%
	Asian	2.2%
	Other	1.7%
	Native American	1.1%
Parent Education	Less than High School	2.2%
	High School/GED	6.6%
	Some College	23.8%
	Technical School Degree	2.8%
	Associate Degree	17.1%
	Bachelor's Degree	29.3%
	Master's Degree	15.5%
	Ph.D. or M.D. or professional doctorate	2.8%
Household Income	Under $10,000	6.3%
	$10,000 - $20,000	14.9%
	$21,000 - $40,000	21.7%
	$41,000 - $60,000	30.9%
	$61,000 - $100,000	21.7%
	Over $100,000	4.6%

Table 1 (cont'd)

Note. $^{**}p < .01$, $^{*}p < .05$. Data on ethnicity was provided by 65% of mothers and 41% of fathers; ethnic categories do not sum to 100% because participants could endorse multiple categories. Data on family income was provided by 63% of mothers and 39% of fathers.

Table 2

Bivariate Associations between PPVT-II Scaled Scores and EC Factor Scores

Traits	1	2	3	4	5	6	7	8	9
1. PPVT-II	1.00								
2. Maternal CBQ EC Factor	.18**	1.00							
3. EC Experimenter Ratings Factor	.28**	.18**	1.00						
4. EC Global Codes Factor	.29**	.24**	.62**	1.00					
5. EC Performance Factor	-.17*	-.15	-.48**	-.51**	1.00				
6. Hand Game	.23*	.10	.30**	.24*	-.23*	1.00			
7. Day/Night	.23**	.18	.21**	.30**	-.08	.14	1.00		
8. Digit Span	-.06	.15	-.08	.20	.01	-	.37*	1.00	
9. Letter-Number Sequencing	.24	.20	.17	.27	-.23	-	.53**	.39**	1.00

Note: $p < .05$*, $p < .01$**, Correlations could not be calculated between Digit Span and Letter-Number Sequencing and the Hand Game (denoted by '-') because the Hand Game was administered for children ages 3-5 years and Digit Span and Letter-Number Sequencing was administered for children ages 6-7 years.

Table 3

Reliability Coefficients for Maternal Reported CBQ Scales

Subscale	Number of Items	Cronbach's α Coefficient
Effortful Control	61	.89
Negative Emotionality	62	.90
Positive Emotionality	62	.93

Table 4

Reliability Coefficients for Maternal Reported CBCL Scales at Baseline and 6-month Follow-up

Subscale	Number of Items	Cronbach's α Coefficient
Reliability at Baseline		
Externalizing	28	.86
Internalizing	27	.79
Attention Problems	10	.78
Anxious/Depressed	12	.76
Reliability at 6-month Follow-up		
Externalizing	28	.88
Internalizing	27	.83
Attention Problems	10	.80
Anxious/Depressed	12	.73

Table 5

Exploratory Factor Analysis with Child Behavior Questionnaire

Trait	PE	NE	EC
Impulsivity	**.88**	-.03	-.29
Activity Level	**.72**	-.24	-.22
Shyness	**-.70**	-.25	-.06
High Intensity Pleasure	**.68**	.12	-.09
Smiling	**.68**	.11	.40[a]
Approach	**.51**	-.48[a]	.17
Anger	.14	**-.79**	-.19
Sadness	-.06	**-.78**	.06
Discomfort	-.10	**-.66**	.05
Soothability	.07	**.62**	.39
Fear	-.36	**-.53**	.10
Attentional Shifting	-.14	**.51**	**.41**
Inhibitory Control	-.35	.34	**.73**
Low Intensity Pleasure	.02	-.01	**.72**
Attentional Focusing	-.29	.20	**.56**
Perceptual Sensitivity	.14	-.25	**.49**

Note. Items loading onto each factor are in bold. [a]Loadings ≥ .40.

Table 6

Exploratory Factor Analysis with Child Behavior Questionnaire EC Subscale

Trait	EC Factor 1	EC Factor 2
Inhibitory Control	**.95**	.34
Attentional Focusing	**.59**	.35
Low Intensity Pleasure	**.53**	**.52**
Attentional Shifting	**.50**	.08
Perceptual Sensitivity	.22	**.72**

Note. Items loading onto each factor are in bold. [a]Loadings ≥ .40.

Table 7

Exploratory Factor Analysis with Child Behavior Questionnaire EC Subscale

Trait	EC
Inhibitory Control	.87
Attentional Focusing	.64
Low Intensity Pleasure	.61
Attentional Shifting	.45
Perceptual Sensitivity	.33

Table 8

Exploratory Factor Analysis with Child Behavior Questionnaire EC Subscale

Trait	EC
Inhibitory Control	.93
Attentional Focusing	.62
Low Intensity Pleasure	.55
Attentional Shifting	.48

Table 9

Exploratory Factor Analysis with Child Behavior Questionnaire EC Parcels

Trait	EC Factor 1	EC Factor 2	EC Factor 3	EC Factor 4
Inhibitory Control Parcel 1	**.62**	-.36	-.09	.04
Inhibitory Control Parcel 2	**.64**	-.01	-.15	.03
Inhibitory Control Parcel 3	**.70**	-.29	-01	.16
Attentional Shifting Parcel 1	.35	**-.47**	.27	.25
Attentional Shifting Parcel 2	**.47**	-.30	.46[a]	.16
Attentional Shifting Parcel 3	**.34**	-.27	.24	.05
Perceptual Sensitivity Parcel 1	.29	**.66**	.08	.28
Perceptual Sensitivity Parcel 2	.48[a]	**.64**	.04	.14
Perceptual Sensitivity Parcel 3	.45[a]	**.59**	.05	.21
Low Intensity Pleasure Parcel 1	**.60**	.09	.13	-.33
Low Intensity Pleasure Parcel 2	**.69**	.02	.02	-.21
Low Intensity Pleasure Parcel 3	**.46**	.31	.29	-.43[a]
Attentional Focusing Parcel 1	**.46**	-.09	-.45[a]	.11
Attentional Focusing Parcel 2	**.49**	.02	-.26	-.07
Attentional Focusing Parcel 3	**.64**	-.17	-.30	-.08

Note. Items loading onto each factor are in bold. [a]Loadings $\geq .40$.

Table 10

Exploratory Factor Analysis with Child Behavior Questionnaire EC Parcels

Trait	EC Factor 1	EC Factor 2	EC Factor 3
Inhibitory Control Parcel 1	**.63**	.55[a]	.27
Inhibitory Control Parcel 2	**.61**	.34	.39
Inhibitory Control Parcel 3	**.64**	.63[a]	.32
Attentional Shifting Parcel 1	.24	**.68**	.05
Attentional Shifting Parcel 2	.21	**.72**	.29
Attentional Shifting Parcel 3	.21	**.49**	.20
Low Intensity Pleasure Parcel 1	.41[a]	.30	**.68**
Low Intensity Pleasure Parcel 2	.56[a]	.38	**.62**
Low Intensity Pleasure Parcel 3	.18	.15	**.74**
Attentional Focusing Parcel 1	**.64**	.15	.09
Attentional Focusing Parcel 2	**.53**	.17	.29
Attentional Focusing Parcel 3	**.71**	.34	.34

Note. Items loading onto each factor are in bold. [a]Loadings ≥ .40.

Table 11

Exploratory Factor Analysis with Child Behavior Questionnaire EC Parcels

Trait	EC Factor 1	EC Factor 2
Inhibitory Control Parcel 1	**.61**	.57[a]
Inhibitory Control Parcel 2	**.65**	.35
Inhibitory Control Parcel 3	**.64**	.64[a]
Attentional Shifting Parcel 1	.21	**.72**
Attentional Shifting Parcel 2	.31	**.66**
Attentional Shifting Parcel 3	.26	**.49**
Low Intensity Pleasure Parcel 1	**.59**	.26
Low Intensity Pleasure Parcel 2	**.70**	.35
Low Intensity Pleasure Parcel 3	**.41**	.12
Attentional Focusing Parcel 1	**.49**	.21
Attentional Focusing Parcel 2	**.53**	.18
Attentional Focusing Parcel 3	**.69**	.36

Note. Items loading onto each factor are in bold. [a]Loadings ≥ .40.

Table 12

Confirmatory Factor Analysis Fit Indicators for Models of EC Assessed by Maternal Report on CBQ

Model	χ^2	*df*	AIC	BIC	CFI	TLI	SRMR	RMSEA	90% CI
<u>CBQ</u>									
Unidimensional Model 1	491.23	(90)	8977.33	9129.64	.61	.54	.12	.14	(.13-.16)
Unidimensional Model 2	214.99	(54)	7164.85	7286.70	.78	.73	.08	.12	(.10-.13)
Multidimensional Model	356.42	(89)	8844.53	9000.21	.74	.69	.12	.12	(.11-.13)
Correlated 5-Factor Model	139.45	(80)	8645.55	8831.70	.94	.93	.06	.06	(.04-.07)
Correlated 4-Factor Model	87.79	(48)	7049.66	7191.81	.95	.93	.05	.06	(.04-.08)

Note. CBQ Unidimensional Model 1 was run with all 15 EC parcels; Unidimensional Model 2 was run without the 3 perceptual sensitivity parcels; Multidimensional Model was fit with the inhibitory control, attentional shifting, and attentional focusing parcels loading on factor 1 and the perceptual sensitivity and low intensity pleasure subscales loading on factor 2; Correlated 5-Factor Model 1 was run with all 15 EC parcels; Correlated 4-Factor Model was run without the 3 perceptual sensitivity parcels.

Table 13

Exploratory Factor Analysis with Child Behavior Scale Variables (Experimenter Ratings)

Trait	EC	PE	NE
Cooperation with child tester	**.90**	-.07	-.33
Cooperation with parent	**.85**	-.10	-.35
Attention to tasks	**.84**	-.14	-.35
Adaptation to change in test materials	**.74**	-.09	-.20
Impulsivity	**-.62**	.52[a]	.28
Persistence in attempting to complete tasks	**.63**	.05	-.38
Interest in test materials and stimuli	**.56**	.53[a]	-.16
Contentment	**.41**	.18	-.09
Exuberance	-.06	**.80**	.15
Overall positive affect	.17	**.77**	-.05
Energy	-.22	**.77**	-.03
Social engagement with child tester	.13	**.69**	-.11
Enthusiasm	.46[a]	**.62**	-.18
Hyperactivity	-.43[a]	**.62**	.21
Shyness	.13	**-.58**	.05
Anticipatory positive affect	.09	**.50**	.15
Initiative with tasks	.08	**.46**	-.10
Exploration of objects	.01	**.44**	-.16
Social engagement with parent	-.13	**.40**	-.04
Overall negative affect	-.41[a]	-.02	**.82**
Prone to sadness	-.18	-.03	**.77**
Prone to anger/irritability	-.49[a]	.09	**.70**
Frustration with inability to complete tasks	-.34	.04	**.66**
Fear (refers to reactions to objects/situations, not shyness)	-.04	-.13	**.54**

Note. Items loading onto each factor are in bold. [a]Loadings ≥ .40

Table 14

Exploratory Factor Analysis with Child Behavior Scale EC Variables (Experimenter Ratings)

Trait	EC Factor 1	EC Factor 2
Cooperation with child tester	**.90**	.58[a]
Cooperation with parent	**.84**	.52[a]
Attention to tasks	**.83**	.52[a]
Impulsivity	**-.75**	-.06
Adaptation to change in test materials	**.73**	.51[a]
Persistence in attempting to complete tasks	**.60**	.54[a]
Interest in test materials and stimuli	.35	**.76**
Contentment	.32	**.45**

Note. Items loading onto each factor are in bold. [a]Loadings ≥ .40

Table 15

Exploratory Factor Analysis with Child Behavior Scale EC Variables (Experimenter Ratings)

Trait	EC
Cooperation with child tester	.93
Cooperation with parent	.86
Attention to tasks	.85
Adaptation to change in test materials	.76
Persistence in attempting to complete tasks	.66
Impulsivity	-.61
Interest in test materials and stimuli	.48
Contentment	.40

Table 16

Exploratory Factor Analysis with Child Behavior Scale EC Variables (Experimenter Ratings)

Trait	EC Factor 1	EC Factor 2	EC Factor 3
Adaptation to change in test materials	**.74**	.30	.60[a]
Attention to tasks	.80[a]	.22	**.93**
Cooperation with parent	**.88**	.27	.75[a]
Impulsivity	**-.69**	.20	-.62[a]
Cooperation with child tester	**.95**	.32	.80[a]
Persistence in attempting to complete tasks	.58[a]	.36	**.69**
Interest in test materials and stimuli	.41[a]	**.72**	.46[a]
Contentment	.36	**.38**	.36

Note. Items loading onto each factor are in bold. [a]Loadings ≥ .40

Table 17

Confirmatory Factor Analysis Fit Indicators for Models of EC Assessed by Experimenter Ratings

Model	χ^2	*df*	AIC	BIC	CFI	TLI	SRMR	RMSEA	90% CI
<u>Experimenter Ratings</u>									
Unidimensional Model	112.43	20	5645.33	5732.22	.93	.90	.06	.13	(.11-.15)
Multidimensional Model 1	87.28	19	5622.19	5712.70	.95	.92	.05	.11	(.09-.14)
Multidimensional Model 2	97.62	19	5632.53	5723.04	.94	.91	.05	.12	(.10-.15)
Multidimensional Model 3	94.44	19	5629.35	5719.86	.94	.91	.06	.12	(.10-.15)

Note. CBQ Unidimensional model 1 was run with all 15 EC parcels; Multidimensional Model 1 was fit with the interest in test materials, contentment, attention, and persistence experimenter ratings loading onto factor 1, and the adaptation to change, cooperation with experimenter, cooperation with parent, and impulsivity experimenter ratings loading onto factor 2. Multidimensional Model 2 was run with the interest in test materials, contentment, and persistence experimenter ratings loading onto factor 1, and the adaptation to change, cooperation with experimenter, cooperation with parent, impulsivity, and attention experimenter ratings loaded onto factor 2; Multidimensional Model 3 was run with the interest in test materials, attention, persistence, and impulsivity experimenter ratings loading onto factor 1, and the adaptation to change, cooperation with experimenter, cooperation with parent, and contentment experimenter ratings loading onto factor 2.

Table 18

Exploratory Factor Analysis with Global Behavior Ratings

Trait	Factor 1	Factor 2
Sociability	**.88**	-.16
Initiative	**.83**	-.52[a]
Interest	**.83**	.07
Activity	**.69**	-.60[a]
Attentional Control	-.06	**.84**
Impulsivity	.50	**-.76**
Compliance	-.10	**.75**

Note. Items loading onto each factor are in bold. [a]Loadings ≥ .40

Table 19

Exploratory Factor Analysis with EC Performance-based Ratings

Trait	Factor 1
Number of times child stepped outside of circle during Balloon Bop	.61
Number of errors during Snack Delay	.52
Number of times child touched the M&M during Snack Delay	.47
Number of self-corrected errors during Snack Delay	.33
Number of prompts given in Snack Delay	.27
Number correct responses on Simon Says	.20

Table 20

Exploratory Factor Analysis with EC Performance-based Ratings

Trait	Factor 1	Factor 2
Number of times child stepped outside of circle during Balloon Bop	**.67**	.20
Number of errors during Snack Delay	**.48**	.30
Number of times child touched the M&M during Snack Delay	**.45**	.22
Number of self-corrected errors during Snack Delay	**.36**	.07
Number of prompts given in Snack Delay	.19	**.67**
Number correct responses on Simon Says	.14	**.30**

Note. Items loading onto each factor are in bold.

Table 21

Exploratory Factor Analysis with EC Global Codes and Performance-based Ratings

Trait	Factor 1
Compliance global rating	.81
Impulsivity global rating	.80
Attentional control global rating	.72
Number of times child stepped outside of circle during Balloon Bop	.51
Number of times child touched the M&M during Snack Delay	.40
Number of prompts given in Snack Delay	.33
Number correct responses on Simon Says	.30
Number of errors during Snack Delay	.30
Number of self-corrected errors during Snack Delay	.22

Table 22

Exploratory Factor Analysis with EC Global Codes and Performance-based Ratings

Trait	Factor 1	Factor 2
Compliance global rating	**.70**	.63[a]
Impulsivity global rating	**.85**	.46[a]
Attentional control global rating	**.85**	.36
Number correct responses on Simon Says	**.33**	.14
Number of times child stepped outside of circle during Balloon Bop	.35	**.62**
Number of errors during Snack Delay	.10	**.57**
Number of times child touched the M&M during Snack Delay	.29	**.42**
Number of prompts given in Snack Delay	.25	**.32**
Number of self-corrected errors during Snack Delay	.15	**.27**

Note. Items loading onto each factor are in bold. [a]Loadings ≥ .40

Table 23

Exploratory Factor Analysis with EC Global Codes and Performance-based Ratings

Trait	Factor 1	Factor 2	Factor 3
Attentional control global rating	**.86**	.34	-.10
Impulsivity global rating	**.85**	.45[a]	-.12
Compliance global rating	**.69**	.54[a]	-.45[a]
Number correct responses on Simon Says	**.33**	.09	-.16
Number of times child stepped outside of circle during Balloon Bop	.33	**.70**	-.11
Number of errors during Snack Delay	.09	**.50**	-.25
Number of times child touched the M&M during Snack Delay	.28	**.43**	-.10
Number of self-corrected errors during Snack Delay	.14	**.32**	.02
Number of prompts given in Snack Delay	.26	.18	**-.80**

Note. Items loading onto each factor are in bold. [a]Loadings ≥ .40

Table 24

Confirmatory Factor Analysis Fit Indicators for Models of EC Assessed by Performance-Based Measures Derived from Objective Coding

Model	χ^2	*df*	AIC	BIC	CFI	TLI	SRMR	RMSEA	90% CI
Performance-based Measures									
Unidimensional Model	17.22	9	2401.74	2461.20	.81	.68	.08	.07	(.01-.02)

Table 25

Confirmatory Factor Analysis Fit Indicators for Models of EC Assessed by Global Behavior Ratings and Performance-based Measures Derived from Objective Coding

Model	χ^2	*df*	AIC	BIC	CFI	TLI	SRMR	RMSEA	90% CI
Global Behavior Ratings and Performance-based Measures									
Unidimensional Model	47.49	27	4314.24	4411.30	.95	.93	.07	.05	(.03-.08)
Multidimensional Model	46.05	19	4314.80	4415.46	.95	.93	.07	.05	(.03-.08)

Note. The multidimensional model was fit with compliance, attentional control, and impulsivity global codes and the Simon Says total score loading onto factor 1, and the number of self-corrected errors during Snack Delay, number of errors made during Snack Delay, number of times each child touched the M&M during Snack Delay, the number of prompts given during Snack Delay, and the number of instances the each child stepped outside of the circle in Balloon Bop loading onto factor 2.

Table 26

Bivariate Associations between Attentional Control Measures

	1	2	3	4
1. Hand Game	1.00			
2. Day/Night	.16	1.00		
3. Digit Span	-	.37*	1.00	
Letter-Number Sequencing	-	.53**	.39**	1.00

Note. ** $p < .01$, * $p < .05$. Correlations could not be computed between all variables because all tasks were administered for all children.

Table 27

Exploratory Factor Analysis with All Methods of Assessment of EC

Trait	EC Factor 1	EC Factor 2
Attentional control global rating	**.83**	.22
Compliance global rating	**.81**	.15
Impulsivity global rating	**.70**	.16
Experimenter Ratings Composite	**.70**	.16
EC Performance Composite	**.62**	.21
CBQ Inhibitory Control Factor	.29	**.97**
CBQ Low Intensity Pleasure Factor	-.02	**.60**
CBQ Attentional Focusing Factor	.30	**.58**
CBQ Attentional Shifting Factor	.15	**.49**

Note. Items loading onto each factor are in bold.

Table 28

Exploratory Factor Analysis with All Methods of Assessment of EC

Trait	EC Factor 1
Attentional control global rating	.81
Compliance global rating	.75
Experimenter Ratings Composite	.68
Impulsivity global rating	.67
EC Performance Composite	.63
CBQ Inhibitory Control Factor	.44
CBQ Attentional Focusing Factor	.42
CBQ Attentional Shifting Factor	.26
CBQ Low Intensity Pleasure Factor	.14

Table 29

Exploratory Factor Analysis with All Methods of Assessment of EC

Trait	EC Factor 1	EC Factor 2	EC Factor 3
Attentional control global rating	**.82**	-.27	-.30
Compliance global rating	**.74**	-.30	-.07
Impulsivity global rating	**.65**	-.23	.01
Experimenter Ratings Composite	**.65**	-.24	-.01
EC Performance Composite	**.65**	-.17	.44[a]
CBQ Attentional Focusing Factor	**.46**	.40[a]	.15
CBQ Inhibitory Control Factor	.57[a]	**.77**	-.00
CBQ Low Intensity Pleasure Factor	.19	**.59**	.01
CBQ Attentional Shifting Factor	.30	**.41**	-.22

Note. Items loading onto each factor are in bold. [a]Loadings ≥ .40

Table 30

Confirmatory Factor Analysis Fit Indicators for Models of EC Assessed by all Methods of Assessment

Model	χ^2	*df*	AIC	BIC	CFI	TLI	SRMR	RMSEA	90% CI
<u>All Methods of Assessment</u>									
Unidimensional Model	211.76	27	5453.75	5551.50	.73	.64	.12	.16	(.14-.18)
Multidimensional Model	44.05	26	5288.04	5389.41	.97	.96	.05	.05	(.02-.08)

Note. The multidimensional model was fit with the experimenter ratings composite, the performance ratings composite, and the EC global behavior codes (compliance, attentional control, impulsivity) loading onto factor 1, and the CBQ EC factors (inhibitory control, attentional shifting, attentional focusing, and low intensity pleasure) loading onto factor 2.

Table 31

Bivariate Associations between EC Factors

Traits	1	2	3	4	5	6	7	8	9	10	11	12	13
Parent Report:													
1. Inhibitory Control	1.00												
2. Attentional Shifting	.47**	1.00											
3. Attentional Focusing	.59**	.23**	1.00										
4. Low Intensity Pleasure	.47**	.29**	.37**	1.00									
5. EC CBQ Factor	.81**	.59**	.71**	.74**	1.00								
Experimenter Ratings:													
6. Experimenter Rating Factor	.23**	.13	.19**	-.02	.18**	1.00							
Global Codes:													
7. Compliance	.22**	.18**	.27**	.03	.22**	.56**	1.00						
8. Attn Control	.28**	.18**	.29**	.04	.24**	.58**	.67**	1.00					
9. Impulsivity	.18**	.07	.18**	.00	.13	.45**	.52**	.58**	1.00				
10. Global Code Composite	.28**	.17*	.29**	.02	.24**	.62**	.86**	.88**	.82**	1.00			

Table 31 (cont'd)

Performance Ratings:													
11. SS: No. Correct	.23*	.15	.19	.04	.14	.22*	.29**	.38**	.25*	.38**	1.00		
12. BB: Outside of Circle	.06	-.08	.18	.08	.07	.38**	.36**	.29**	.32**	.37**	.15	1.00	
13. SD: Errors	.07	-.08	.26**	.07	.09	.27**	.22**	.13	.18*	.20*	-.02	.29**	1.00
14. SD: Self-Corrected Errors	.29**	.09	.31**	.18*	.29**	.19*	.16	.20*	.27**	.23**	-.01	.06	.14
15. SD: Touches	.14	.01	.12	.03	.10	.32**	.43**	.33**	.34**	.42**	.01	.28**	.17*
16. SD: # of Prompts	.12	.12	.05	-.12	-.01	.38**	.44**	.32**	.27**	.41**	.37**	.08	.32**
17. Performance Ratings Composite	.23*	.03	.30**	.04	.17	.50**	.55**	.46**	.48**	.57**	.48**	.57**	.64**
Attentional Control Measures:													
18. Hand Game	.18	-.01	.12	-.04	.10	.30**	.22*	.21*	.22*	.24*	.28*	-.28*	-.22
19. Day/Night	.25**	.11	.18	.02	.18	.21**	.26**	.31**	.19*	.30**	.31**	-.20	.01
20. Digit Span	.20	.10	.24	-.04	.15	-.08	.24	.26	.00	.20	.06	-.09	-.06
21. L-N Sequencing	.15	-.10	.27	.20	.20	.17	.34*	.26	.06	.27	.25	-.15	-.28

Table 31 (cont'd)

	14	15	16	17	18	19	20	21
14. SD: Self-Corrected Errors	1.00							
15. SD: Touches	.18*	1.00						
16. SD: # of Prompts	.09	.17*	1.00					
17. Performance Ratings Composite	.48**	.60**	.64**	1.00				
Attentional Control Measures:								
18. Hand Game	-.07	.21	.12	.22	1.00			
19. Day/Night	.03	.15	.16	.24*	.16	1.00		
20. Digit Span	.03	-.04	.22	.08	-	.37*	1.0	
21. L-N Sequencing	-.09	.41*	.40*	.37*	-	.53**	.39**	1.00

Note. ** $p < .01$, * $p < .05$, SS: No. Correct = Number correct during Simon Says, BB: Outside of Circle = Number of times each child stepped outside of the circle during Balloon Bop, SD: Errors = Number of errors during Snack Delay, SD: Self-Corrected Errors = Number of self-corrected errors during Snack Delay, SD: Touches = Number of times each child touched the M&M during Snack Delay, SD: # of Prompts = Number of prompts given during Snack Delay, L-N Sequencing = Letter-Number Sequencing, Correlations could not be calculated between Digit Span and Letter-Number Sequencing and the Hand Game (denoted by '-') because the Hand Game was administered for children ages 3-5 years and Digit Span and Letter-Number Sequencing was administered for children ages 6-7 years.

Table 32

Hierarchical Regression with Maternal Reported EC on the CBQ Predicting Maternal Reported Externalizing Behavior on the CBCL

Predictor	β	t	p	R	R^2	ΔR^2	ΔF	p
Step 1				.14	.02	.12	2.00	.14
Age	.11	1.66	.10	-	-	-	-	-
Sex	-.07	-1.10	.29	-	-	-	-	-
Step 2								
Maternal EC on CBQ	-.46	-7.30	< .001	.46	.22	.20	53.26	< .001

Table 33

Hierarchical Regression with Maternal Reported EC Subscales on the CBQ Predicting Maternal Reported Externalizing Behavior on the CBCL

Predictor	β	*t*	*p*	*R*	R^2	ΔR^2	ΔF	*p*
Step 1				.14	.02	.02	2.00	.14
Age	.11	1.66	.10	-	-	-	-	-
Sex	-.07	-1.10	.29	-	-	-	-	-
Step 2				.51	.26	.24	16.76	< .001
Inhibitory Control	-.35	-4.01	< .001	-	-	-	-	-
Attentional Shifting	-.17	-2.53	< .05	-	-	-	-	
Low Intensity Pleasure	.07	.96	.34	-	-	-	-	-
Attentional Focusing	-.13	-1.69	.09	-	-	-	-	-

Table 34

Hierarchical Regression with Maternal Reported EC on the CBQ Predicting Maternal Reported Internalizing Behavior on the CBCL

Predictor	β	*t*	*p*	*R*	R^2	ΔR^2	ΔF	*p*
Step 1				.31	.10	.10	11.19	< .001
Age	.28	4.35	< .001	-	-	-	-	-
Sex	.13	2.03	< .05	-	-	-	-	-
Step 2								
Maternal EC on CBQ	-.16	-2.42	< .05	.35	.12	.02	4.86	< .05

Table 35

Hierarchical Regression with Maternal Reported EC Subscales on the CBQ Predicting Maternal Reported Internalizing Behavior on the CBCL

Predictor	β	*t*	*p*	*R*	R^2	ΔR^2	ΔF	*p*
Step 1				.31	.10	.10	11.19	< .001
Age	.28	4.35	< .001	-	-	-	-	-
Sex	.13	2.03	< .05	-	-	-	-	-
Step 2				.39	.15	.06	3.53	< .01
Inhibitory Control	-.08	-.83	.41	-	-	-	-	-
Attentional Shifting	-.21	-2.86	< .01	-	-	-	-	-
Low Intensity Pleasure	-.01	-.13	.90	-	-	-	-	-
Attentional Focusing	.08	.95	.34	-	-	-	-	-

Table 36

Hierarchical Regression with Maternal Reported EC on the CBQ Predicting Maternal Reported Attention Problems on the CBCL

Predictor	β	*t*	*p*	*R*	R^2	ΔR^2	ΔF	*p*
Step 1				.13	.02	.02	1.87	.16
Age	.02	.33	.74	-	-	-	-	-
Sex	-.13	-1.89	.06	-	-	-	-	-
Step 2								
Maternal EC on CBQ	-.62	-11.32	< .001	.62	.39	.37	128.11	< .001

Table 37

Hierarchical Regression with Maternal Reported EC Subscales on the CBQ Predicting Maternal Reported Attention Problems on the CBCL

Predictor	β	*t*	*p*	*R*	R^2	ΔR^2	ΔF	*p*
Step 1				.13	.02	.02	1.87	.16
Age	.02	.33	.74	-	-	-	-	-
Sex	-.13	-1.89	.06	-	-	-	-	-
Step 2				.67	.45	.43	41.43	< .001
Inhibitory Control	-.30	-3.97	< .001	-	-	-	-	-
Attentional Shifting	-.30	-5.18	< .001	-	-	-	-	-
Low Intensity Pleasure	.09	1.36	.18	-	-	-	-	-
Attentional Focusing	-.31	-4.80	< .001	-	-	-	-	-

Table 38

Hierarchical Regression with Maternal Reported EC on the CBQ Predicting Maternal Reported Anxious/Depressed Behavior on the CBCL

Predictor	β	*t*	*p*	*R*	R^2	ΔR^2	ΔF	*p*
Step 1				.34	.12	.12	14.15	< .001
Age	.33	5.08	< .001	-	-	-	-	-
Sex	.11	1.76	.08	-	-	-	-	-
Step 2								
Maternal EC on CBQ	-.16	-2.52	< .05	.38	.14	.03	6.34	< .05

Table 39

Hierarchical Regression with Maternal Reported EC Subscales on the CBQ Predicting Maternal Reported Anxious/Depressed Behavior on the CBCL

Predictor	β	t	p	R	R^2	ΔR^2	ΔF	p
Step 1				.34	.12	.12	14.15	< .001
Age	.33	5.08	< .001	-	-	-	-	-
Sex	.11	1.76	.08	-	-	-	-	-
Step 2				.41	.17	.05	3.10	< .05
Inhibitory Control	-.09	-.93	.35	-	-	-	-	-
Attentional Shifting	-.18	-2.51	< .05	-	-	-	-	-
Low Intensity Pleasure	.05	.70	.50	-	-	-	-	-
Attentional Focusing	.00	.00	1.00	-	-	-	-	-

Table 40

Hierarchical Regression with Experimenter Ratings of EC Predicting Maternal Reported Externalizing Behavior on the CBCL

Predictor	β	*t*	*p*	*R*	R^2	ΔR^2	ΔF	*p*
Step 1				.14	.02	.02	2.18	.12
Age	.12	1.77	.08	-	-	-	-	-
Sex	-.07	-1.03	.31	-	-	-	-	-
Step 2								
Experimenter Ratings of EC	-.21	-2.91	< .01	.24	.06	.04	8.45	< .01

Table 41

Hierarchical Regression with Experimenter Ratings of EC Predicting Maternal Reported Internalizing Behavior on the CBCL

Predictor	β	*t*	*p*	*R*	R^2	ΔR^2	ΔF	*p*
Step 1				.31	.09	.09	11.00	< .001
Age	.28	4.33	< .001	-	-	-	-	-
Sex	.13	2.00	< .05	-	-	-	-	-
Step 2								
Experimenter Ratings of EC	.03	.36	.72	.31	.09	.00	.13	.72

Table 42

Hierarchical Regression with Experimenter Ratings of EC Predicting Maternal Reported Attention Problems on the CBCL

Predictor	β	*t*	*p*	*R*	R^2	ΔR^2	ΔF	*p*
Step 1				.13	.02	.02	1.80	.17
Age	.03	.37	.71	-	-	-	-	-
Sex	-.13	-1.84	.07	-	-	-	-	-
Step 2								
Experimenter Ratings of EC	-.21	-2.90	< .01	.23	.05	.04	8.39	< .01

Table 43

Hierarchical Regression with Experimenter Ratings of EC Predicting Maternal Reported Anxious/Depressed Behavior on the CBCL

Predictor	β	*t*	*p*	*R*	R^2	ΔR^2	ΔF	*p*
Step 1				.34	.12	.12	13.81	< .001
Age	.33	5.05	< .001	-	-	-	-	-
Sex	.11	1.70	.09	-	-	-	-	-
Step 2								
Experimenter Ratings of EC	.01	.19	.85	.34	.12	.00	.03	.85

Table 44

Hierarchical Regression with Global and Performance Ratings of EC Predicting Maternal Reported Externalizing Behavior on the CBCL

Predictor	β	*t*	*p*	*R*	R^2	ΔR^2	ΔF	*p*
Step 1				.14	.02	.02	2.18	.12
Age	.12	1.75	.08	-	-	-	-	-
Sex	-.07	-1.07	.29	-	-	-	-	-
Step 2								
Global and Performance Ratings of EC	-.03	-.36	.72	.15	.02	.00	.13	.72

Table 45

Hierarchical Regression with Global and Performance Ratings of EC Predicting Maternal Reported Internalizing Behavior on the CBCL

Predictor	β	*t*	*p*	*R*	R^2	ΔR^2	ΔF	*p*
Step 1				.31	.10	.10	11.15	< .001
Age	.29	4.32	< .001	-	-	-	-	-
Sex	.13	2.01	< .05	-	-	-	-	-
Step 2								
Global and Performance Ratings of EC	-.07	-1.02	.31	.32	.10	.00	1.04	.31

Table 46

Hierarchical Regression with Global and Performance Ratings of EC Predicting Maternal Reported Attention Problems on the CBCL

Predictor	β	t	p	R	R^2	ΔR^2	ΔF	p
Step 1				.13	.02	.02	1.66	.19
Age	.03	.46	.65	-	-	-	-	-
Sex	-.12	-1.75	.08	-	-	-	-	-
Step 2								
Global and Performance Ratings of EC	-.09	-1.28	.20	.15	.02	.01	1.63	.20

Table 47

Hierarchical Regression with Global and Performance Ratings of EC Predicting Maternal Reported Anxious/Depressed Behavior on the CBCL

Predictor	β	t	p	R	R^2	ΔR^2	ΔF	p
Step 1				.35	.12	.12	14.12	< .001
Age	.24	2.78	< .01	-	-	-	-	-
Sex	.07	.81	.42	-	-	-	-	-
Step 2								
Global and Performance Ratings of EC	-.01	-.15	.88	.36	.13	.01	2.01	.16

Table 48

Hierarchical Regression with Maternal Reported EC on the CBQ Predicting Maternal Reported Externalizing Behavior on the CBCL at 6-month Follow-up

Predictor	β	*t*	*p*	*R*	R^2	ΔR^2	ΔF	*p*
Step 1				.59	.35	.35	29.80	< .001
Age	.02	.38	.71	-	-	-	-	-
Sex	-.03	-.49	.63	-	-	-	-	-
Externalizing Behavior on CBCL at Baseline	.58	9.34	< .001					
Step 2								
Maternal Reported EC	-.24	-3.58	< .001	.63	.39	.05	12.79	< .001

Table 49

Hierarchical Regression with Maternal Reported EC Subscales on the CBQ Predicting Maternal Reported Externalizing Behavior on the CBCL at 6-month Follow-up

Predictor	β	*t*	*p*	*R*	R^2	ΔR^2	ΔF	*p*
Step 1				.59	.35	.35	29.80	< .001
Age	.02	.38	.71	-	-	-	-	-
Sex	-.03	-.49	.63	-	-	-	-	-
Externalizing Behavior on CBCL at Baseline	.58	9.34	< .001					
Step 2				.64	.40	.06	4.02	< .01
Inhibitory Control	-.12	-1.30	.20	-	-	-	-	-
Attentional Shifting	-.16	-2.17	< .05	-	-	-	-	-
Low Intensity Pleasure	-.08	-1.07	.29	-	-	-	-	-
Attentional Focusing	.02	.22	.82	-	-	-	-	-

Table 50

Hierarchical Regression with Maternal Reported EC on the CBQ Predicting Maternal Reported Internalizing Behavior on the CBCL at 6-month Follow-up

Predictor	β	*t*	*p*	*R*	R^2	ΔR^2	ΔF	*p*
Step 1				.51	.26	.26	19.97	< .001
Age	.11	1.60	.11	-	-	-	-	-
Sex	.06	.89	.37	-	-	-	-	-
Internalizing Behavior on CBCL at Baseline	.46	6.50	< .001					
Step 2								
Maternal Reported EC	-.15	-2.18	< .05	.53	.28	.02	4.75	< .05

Table 51

Hierarchical Regression with Maternal Reported EC Subscales on the CBQ Predicting Maternal Reported Internalizing Behavior on the CBCL 6-month Follow-up

Predictor	β	t	p	R	R^2	ΔR^2	ΔF	p
Step 1				.51	.26	.26	19.97	< .001
Age	.11	1.60	.11	-	-	-	-	-
Sex	.06	.89	.37	-	-	-	-	-
Internalizing Behavior on CBCL at Baseline	.46	6.50	< .001					
Step 2				.55	.31	.05	2.72	< .05
Inhibitory Control	.06	.64	.53	-	-	-	-	-
Attentional Shifting	-.21	-2.69	< .01	-	-	-	-	-
Low Intensity Pleasure	-.10	-1.30	.20	-	-	-	-	-
Attentional Focusing	.01	.14	.89	-	-	-	-	-

Table 52

Hierarchical Regression with Maternal Reported EC on the CBQ Predicting Maternal Reported Attention Problems on the CBCL at 6-month Follow-up

Predictor	β	*t*	*p*	*R*	R^2	ΔR^2	ΔF	*p*
Step 1				.64	.41	.41	38.34	< .001
Age	.02	.38	.71	-	-	-	-	-
Sex	-.06	-1.03	.31	-	-	-	-	-
Attention Problems on CBCL at Baseline	.63	10.52	< .001					
Step 2								
Maternal Reported EC	-.22	-2.77	< .01	.66	.42	.03	7.67	< .01

Table 53

Hierarchical Regression with Maternal Reported EC Subscales on the CBQ Predicting Maternal Reported Attention Problems on the CBCL 6-month Follow-up

Predictor	β	t	p	R	R^2	ΔR^2	ΔF	p
Step 1				.64	.41	.41	38.34	< .001
Age	.02	.38	.71	-	-	-	-	-
Sex	-.06	-1.03	.31	-	-	-	-	-
Attention Problems on CBCL at Baseline	.63	10.52	< .001					
Step 2				.66	.44	.03	2.43	< .05
Inhibitory Control	-.18	-2.05	< .05	-	-	-	-	-
Attentional Shifting	-.07	-.98	.33	-	-	-	-	-
Low Intensity Pleasure	-.00	-.06	.96	-	-	-	-	-
Attentional Focusing	-.04	-.46	.65	-	-	-	-	-

Table 54

Hierarchical Regression with Maternal Reported EC on the CBQ Predicting Maternal Reported Anxious/Depressed Behavior on the CBCL at 6-month Follow-up

Predictor	β	*t*	*p*	*R*	R^2	ΔR^2	ΔF	*p*
Step 1				.55	.30	.30	24.55	< .001
Age	.10	1.39	.17	-	-	-	-	-
Sex	.03	.43	.67	-	-	-	-	-
Anxious/ Depressed Behavior on CBCL at Baseline	.51	7.31	< .001					
Step 2								
Maternal Reported EC	-.04	-.56	.58	.55	.31	.00	.31	.58

Table 55

Hierarchical Regression with Maternal Reported EC Subscales on the CBQ Predicting Maternal Reported Anxious/Depressed Behavior on the CBCL at 6-month Follow-up

Predictor	β	*t*	*p*	*R*	R^2	ΔR^2	ΔF	*p*
Step 1				.55	.30	.30	24.55	< .001
Age	.10	1.39	.17	-	-	-	-	-
Sex	.03	.43	.67	-	-	-	-	-
Anxious/ Depressed Behavior on CBCL at Baseline	.51	7.31	< .001					
Step 2				.56	.32	.02	.98	.42
Inhibitory Control	.00	.03	.98	-	-	-	-	-
Attentional Shifting	-.12	-1.58	.12	-	-	-	-	-
Low Intensity Pleasure	-.02	-.24	.81	-	-	-	-	-
Attentional Focusing	.07	.88	.38	-	-	-	-	-

Table 56

Hierarchical Regression with Experimenter Ratings of EC Predicting Maternal Reported Externalizing Behavior on the CBCL at 6-month Follow-up

Predictor	β	t	p	R	R^2	ΔR^2	ΔF	p
Step 1				.59	.35	.35	30.06	< .001
Age	.02	.31	.75	-	-	-	-	-
Sex	-.03	-.50	.62	-	-	-	-	-
Externalizing Behavior on CBCL at Baseline				-	-	-	-	-
Step 2								
Experimenter Ratings of EC	-.07	-1.07	.29	.60	.35	.00	1.14	.29

Table 57

Hierarchical Regression with Experimenter Ratings of EC Predicting Maternal Reported Internalizing Behavior on the CBCL at 6-month Follow-up

Predictor	β	t	p	R	R^2	ΔR^2	ΔF	p
Step 1				.51	.26	.26	19.93	< .001
Age	.11	1.63	.11	-	-	-	-	-
Sex	.06	.89	.37	-	-	-	-	-
Internalizing Behavior on CBCL at Baseline	.46	6.49	< .001	-	-	-	-	-
Step 2								
Experimenter Ratings of EC	-.05	-.75	.46	.52	.27	.00	.56	.46

Table 58

Hierarchical Regression with Experimenter Ratings of EC Predicting Maternal Reported Attention Problems on the CBCL at 6-month Follow-up

Predictor	β	*t*	*p*	*R*	R^2	ΔR^2	ΔF	*p*
Step 1				.64	.41	.41	38.53	< .001
Age	.03	.56	.58	-	-	-	-	-
Sex	-.06	-1.02	.31	-	-	-	-	-
Attention Problems on CBCL at Baseline	.63	10.54	< .001	-	-	-	-	-
Step 2								
Experimenter Ratings of EC	-.11	-1.67	.10	.65	.42	.01	2.79	.10

Table 59

Hierarchical Regression with Experimenter Ratings of EC Predicting Maternal Reported Anxious/Depressed Behavior on the CBCL at 6-month Follow-up

Predictor	β	*t*	*p*	*R*	R^2	ΔR^2	ΔF	*p*
Step 1				.56	.31	.31	24.95	< .001
Age	.10	1.46	.15	-	-	-	-	-
Sex	.03	.49	.63	-	-	-	-	-
Anxious/ Depressed Behavior on CBCL at Baseline	.51	7.35	< .001	-	-	-	-	-
Step 2								
Experimenter Ratings of EC	.02	-.01	.90	.56	.31	.00	.02	.90

Table 60

Hierarchical Regression with Global and Performance Ratings of EC Predicting Maternal Reported Externalizing Behavior on the CBCL at 6-month Follow-up

Predictor	β	*t*	*p*	*R*	R^2	ΔR^2	ΔF	*p*
Step 1				.59	.34	.34	28.64	< .001
Age	.03	.51	.61	-	-	-	-	-
Sex	-.04	-.55	.58	-	-	-	-	-
Externalizing Behavior on CBCL at Baseline	.58	9.11	< .001	-	-	-	-	-
Step 2								
Global and Performance Ratings of EC	-.09	-1.39	.17	.59	.35	.01	1.94	.17

Table 61

Hierarchical Regression with Global and Performance Ratings of EC Predicting Maternal Reported Internalizing Behavior on the CBCL at 6-month Follow-up

Predictor	β	*t*	*p*	*R*	R^2	ΔR^2	ΔF	*p*
Step 1				.51	.26	.25	19.64	< .001
Age	.12	1.21	.23	-	-	-	-	-
Sex	.05	.55	.58	-	-	-	-	-
Internalizing Behavior on CBCL at Baseline	.36	3.66	< .001	-	-	-	-	-
Step 2								
Global and Performance Ratings of EC	-.05	-.47	.64	.52	.27	.00	.51	.48

Table 62

Hierarchical Regression with Global and Performance Ratings of EC Predicting Maternal Reported Attention Problems on the CBCL at 6-month Follow-up

Predictor	β	*t*	*p*	*R*	R^2	ΔR^2	ΔF	*p*
Step 1				.63	.40	.40	36.58	< .001
Age	.03	.48	.63	-	-	-	-	-
Sex	-.07	-1.12	.27	-	-	-	-	-
Attention Problems on CBCL at Baseline	.62	10.24	< .001	-	-	-	-	-
Step 2								
Global and Performance Ratings of EC	-.10	-1.54	.13	.64	.41	.01	2.37	.13

Table 63

Hierarchical Regression with Global and Performance Ratings of EC Predicting Maternal Reported Anxious/Depressed Problems on the CBCL at 6-month Follow-up

Predictor	β	*t*	*p*	*R*	R^2	ΔR^2	ΔF	*p*
Step 1				.55	.31	.31	24.22	< .001
Age	.0	1.40	.16	-	-	-	-	-
Sex	.02	.34	.74	-	-	-	-	-
Anxious/ Depressed Behavior on CBCL at Baseline	.51	7.24	< .001	-	-	-	-	-
Step 2								
Global and Performance Ratings of EC	-.06	-.95	.35	.56	.31	.00	.89	.35

Table 64

Hierarchical Regression with Digit Span Attentional Control Measure Predicting Maternal Reported Anxious/Depressed Problems on the CBCL at 6-month Follow-up

Predictor	β	*t*	*p*	*R*	R^2	ΔR^2	ΔF	*p*
Step 1				.85	.72	.72	21.27	< .001
Age	.11	.91	.37	-	-	-	-	-
Sex	-.07	-.57	.57	-	-	-	-	-
Anxious/ Depressed Behavior on CBCL at Baseline	.83	7.11	< .001					
Step 2								
Digit Span Attentional Control Measure	-.26	-2.49	< .05	.88	.78	.06	6.21	< .05

Table 65

Hierarchical Regression with Letter-Number Sequencing Attentional Control Measure Predicting Maternal Reported Anxious/Depressed Problems on the CBCL at 6-month Follow-up

Predictor	β	*t*	*p*	*R*	R^2	ΔR^2	ΔF	*p*
Step 1				.85	.72	.72	21.27	< .001
Age	.11	.91	.37	-	-	-	-	-
Sex	-.07	-.57	.57	-	-	-	-	-
Anxious/ Depressed Behavior on CBCL at Baseline	.83	7.11	< .001					
Step 2								
Letter-Number Sequencing Attentional Control Measure	-.24	-2.40	< .05	.88	.77	.06	5.78	< .05

Table 66

Hierarchical Nonlinear Regression with Maternal Reported EC on the CBQ Predicting Maternal Reported Externalizing Behavior on the CBCL

Predictor	β	t	p	R	R^2	ΔR^2	ΔF	p
Step 1				.14	.02	.02	2.00	.14
Age	.11	1.66	.10	-	-	-	-	-
Sex	-.07	-1.06	.29	-	-	-	-	-
Step 2								
Maternal Reported EC	-.46	-7.30	< .001	.43	.18	.16	53.26	< .001
Step 3								
Square of Maternal Reported EC	.04	.64	.52	.47	.22	.00	.41	.52

Table 67

Hierarchical Nonlinear Regression with Maternal Reported EC on the CBQ Predicting Maternal Reported Internalizing Behavior on the CBCL

Predictor	β	*t*	*p*	*R*	R^2	ΔR^2	ΔF	*p*
Step 1				.31	.10	.10	11.19	< .001
Age	.28	4.35	< .001	-	-	-	-	-
Sex	.13	2.03	< .05	-	-	-	-	-
Step 2								
Maternal Reported EC	-.16	-2.42	< .05	.34	.11	.02	5.86	< .05
Step 3								
Square of Maternal Reported EC	.04	.57	.57	.35	.12	.00	.32	.57

Table 68

Hierarchical Nonlinear Regression with Maternal Reported EC on the CBQ Predicting Maternal Reported Attention Problems on the CBCL

Predictor	β	*t*	*p*	*R*	R^2	ΔR^2	ΔF	*p*
Step 1				.13	.02	.02	1.87	.16
Age	.02	.33	.74	-	-	-	-	-
Sex	-.13	-1.89	.06	-	-	-	-	-
Step 2								
Maternal Reported EC	-.62	-11.32	< .001	.62	.39	.37	128.11	< .001
Step 3								
Square of Maternal Reported EC	.10	1.88	.06	.63	.40	.01	3.54	.06

Table 69

Hierarchical Nonlinear Regression with Maternal Reported EC on the CBQ Predicting Maternal Reported Anxious/Depressed Behavior on the CBCL

Predictor	β	*t*	*p*	*R*	R^2	ΔR^2	ΔF	*p*
Step 1				.34	.12	.12	14.15	< .001
Age	.33	5.08	< .001	-	-	-	-	-
Sex	.11	1.76	.08	-	-	-	-	-
Step 2								
Maternal Reported EC	-.16	-2.52	< .05	.38	.14	.03	6.34	< .05
Step 3								
Square of Maternal Reported EC	.01	.09	.03	.38	.14	.00	.01	.93

Table 70

Hierarchical Nonlinear Regression with Experimenter Ratings of EC Predicting Maternal Reported Externalizing Behavior on the CBCL

Predictor	β	*t*	*p*	*R*	R^2	ΔR^2	ΔF	*p*
Step 1				.14	.02	.02	2.18	.12
Age	.12	1.77	.08	-	-	-	-	-
Sex	-.07	-1.03	.31	-	-	-	-	-
Step 2								
Experimenter Ratings of EC	-.21	-2.91	< .01	.24	.06	.04	8.45	< .01
Step 3								
Square of Experimenter Ratings of EC	-.11	-1.40	.16	.26	.07	.01	1.95	.16

Table 71

Hierarchical Nonlinear Regression with Experimenter Ratings of EC Predicting Maternal Reported Internalizing Behavior on the CBCL

Predictor	β	*t*	*p*	*R*	R^2	ΔR^2	ΔF	*p*
Step 1				.31	.09	.09	11.00	< .001
Age	.28	4.33	< .001	-	-	-	-	-
Sex	.13	2.00	< .05	-	-	-	-	-
Step 2								
Experimenter Ratings of EC	.03	.36	.72	.31	.09	.00	.13	.72
Step 3								
Square of Experimenter Ratings of EC	.01	.16	.88	.31	.09	.00	.02	.88

Table 72

Hierarchical Nonlinear Regression with Experimenter Ratings of EC Predicting Maternal Reported Attention Problems on the CBCL

Predictor	β	*t*	*p*	*R*	R^2	ΔR^2	ΔF	*p*
Step 1				.13	.02	.02	1.80	.17
Age	.03	.37	.71	-	-	-	-	-
Sex	-.13	-1.84	.07	-	-	-	-	-
Step 2								
Experimenter Ratings of EC	-.21	-2.90	< .01	.23	.05	.04	8.39	< .01
Step 3								
Square of Experimenter Ratings of EC	-.13	-1.74	.08	.26	.07	.01	3.04	.08

Table 73

Hierarchical Nonlinear Regression with Experimenter Ratings of EC Predicting Maternal Reported Anxious/Depressed Behavior on the CBCL

Predictor	β	t	p	R	R^2	ΔR^2	ΔF	p
Step 1				.34	.12	.12	13.81	< .001
Age	.33	5.05	< .001	-	-	-	-	-
Sex	.11	1.69	.09	-	-	-	-	-
Step 2								
Experimenter Ratings of EC	.01	.19	.85	.34	.12	.00	.03	.85
Step 3								
Square of Experimenter Ratings of EC	-.04	-.58	.56	.34	.12	.00	.34	.56

Table 74

Hierarchical Nonlinear Regression with Global and Performance Ratings of EC Predicting Maternal Reported Externalizing Behavior on the CBCL

Predictor	β	t	p	R	R^2	ΔR^2	ΔF	p
Step 1				.14	.02	.02	2.18	.12
Age	.12	1.75	.08	-	-	-	-	-
Sex	-.07	-1.07	.29	-	-	-	-	-
Step 2								
Global and Performance Ratings of EC	-.03	-.36	.72	.15	.02	.00	.13	.72
Step 3								
Square of Global and Performance Ratings of EC	-.04	-.48	.63	.15	.02	.00	.24	.63

Table 75

Hierarchical Nonlinear Regression with Global and Performance Ratings of EC Predicting Maternal Reported Internalizing Behavior on the CBCL

Predictor	β	*t*	*p*	*R*	R^2	ΔR^2	ΔF	*p*
Step 1				.31	.10	.10	11.15	< .001
Age	.29	4.34	< .001	-	-	-	-	-
Sex	.13	2.01	< .05	-	-	-	-	-
Step 2								
Global and Performance Ratings of EC	-.07	-1.02	.31	.32	.10	.00	1.04	.31
Step 3								
Square of Global and Performance Ratings of EC	.04	.54	.59	.32	.10	.00	.30	.58

Table 76

Hierarchical Nonlinear Regression with Global and Performance Ratings of EC Predicting Maternal Reported Attention Problems on the CBCL

Predictor	β	*t*	*p*	*R*	R^2	ΔR^2	ΔF	*p*
Step 1				.13	.02	.02	1.67	.19
Age	.03	.46	.65	-	-	-	-	-
Sex	-.12	-1.75	.08	-	-	-	-	-
Step 2								
Global and Performance Ratings of EC	-.09	-1.28	.20	.15	.02	.01	1.63	.20
Step 3								
Square of Global and Performance Ratings of EC	.04	.47	.64	.16	.02	.00	.22	.64

Table 77

Hierarchical Nonlinear Regression with Global and Performance Ratings of EC Predicting Maternal Reported Anxious/Depressed Behavior on the CBCL

Predictor	β	*t*	*p*	*R*	R^2	ΔR^2	ΔF	*p*
Step 1				.35	.12	.12	14.12	< .001
Age	.33	5.08	< .001	-	-	-	-	-
Sex	.11	1.74	.08	-	-	-	-	-
Step 2								
Global and Performance Ratings of EC	-.09	-1.42	.16	.36	.13	.01	2.01	.16
Step 3								
Square of Global and Performance Ratings of EC	.02	.23	.82	.36	.13	.00	.05	.82

Table 78

Hierarchical Nonlinear Regression with the Letter-Number Sequencing Attentional Control Measure Predicting Maternal Reported Internalizing Behavior on the CBCL

Predictor	β	t	p	R	R^2	ΔR^2	ΔF	p
Step 1				.46	.21	.21	4.46	< .05
Age	.44	2.63	< .05	-	-	-	-	-
Sex	.39	2.33	< .05	-	-	-	-	-
Step 2								
Letter-Number Sequencing Attentional Control Measure	.22	1.46	.15	.51	.26	.05	2.13	.15
Step 3								
Square of Letter-Number Sequencing Attentional Control Measure	-.31	-2.11	< .05	.59	.35	.09	4.44	< .05

Table 79

Hierarchical Nonlinear Regression with the Hand Game Attentional Control Measure Predicting Maternal Reported Attention Problems on the CBCL

Predictor	β	*t*	*p*	*R*	R^2	ΔR^2	ΔF	*p*
Step 1				.21	.04	.04	1.71	.19
Age	-.02	-.17	.87	-	-	-	-	-
Sex	-.21	-1.85	.07	-	-	-	-	-
Step 2								
Letter-Number Sequencing Attentional Control Measure	-.02	-.13	.90	.21	.04	.00	.02	.90
Step 3								
Square of Letter-Number Sequencing Attentional Control Measure	.40	2.05	< .05	.30	.09	.05	4.21	< .05

Table 80

Hierarchical Nonlinear Regression with the Letter-Number Sequencing Attentional Control Measure Predicting Maternal Reported Anxious/Depressed Behavior on the CBCL

Predictor	β	*t*	*p*	*R*	R^2	ΔR^2	ΔF	*p*
Step 1				.40	.16	.16	3.23	< .05
Age	.35	2.07	< .05	-	-	-	-	-
Sex	.37	2.17	< .05	-	-	-	-	-
Step 2								
Letter-Number Sequencing Attentional Control Measure	.14	.89	.38	.42	.18	.02	.79	.38
Step 3								
Square of Letter-Number Sequencing Attentional Control Measure	-.31	-2.06	< .05	.53	.28	.10	4.23	< .05

Table 81

Hierarchical Nonlinear Regression with Maternal Reported EC on the CBQ Predicting Maternal Reported Externalizing Behavior on the CBCL at 6-month Follow-up

Predictor	β	*t*	*p*	*R*	R^2	ΔR^2	ΔF	*p*
Step 1				.59	.35	.35	29.80	< .001
Age	.02	.38	.71	-	-	-	-	-
Sex	-.03	-.49	.63	-	-	-	-	-
Externalizing Behavior on CBCL at Baseline	.58	9.34	< .001	-	-	-	-	-
Step 2								
Maternal Reported EC	-.24	-3.58	< .001	.63	.39	.05	12.79	< .001
Step 3								
Square of Maternal Reported EC	-.00	-.06	.95	.63	.39	.00	.20	.95

Table 82

Hierarchical Nonlinear Regression with Maternal Reported EC on the CBQ Predicting Maternal Reported Internalizing Behavior on the CBCL at 6-month Follow-up

Predictor	β	*t*	*p*	*R*	R^2	ΔR^2	ΔF	*p*
Step 1				.51	.26	.26	19.97	< .001
Age	.11	1.60	.11	-	-	-	-	-
Sex	.06	.89	.37	-	-	-	-	-
Internalizing Behavior on CBCL at Baseline	.46	6.50	< .001	-	-	-	-	-
Step 2								
Maternal Reported EC	-.15	-2.18	< .05	.53	.28	.02	4.75	< .05
Step 3								
Square of Maternal Reported EC	-.02	-.22	.83	.53	.28	.00	.05	.83

Table 83

Hierarchical Nonlinear Regression with Maternal Reported EC on the CBQ Predicting Maternal Reported Attention Problems on the CBCL at 6-month Follow-up

Predictor	β	*t*	*p*	*R*	R^2	ΔR^2	ΔF	*p*
Step 1				.64	.41	.41	38.34	< .001
Age	.02	.38	.71	-	-	-	-	-
Sex	-.06	-1.03	.31	-	-	-	-	-
Attention Problems on CBCL at Baseline	.63	10.52	< .001	-	-	-	-	-
Step 2								
Maternal Reported EC	-.22	-2.77	< .01	.66	.43	.03	7.67	< .01
Step 3								
Square of Maternal Reported EC	.04	.63	.53	.66	.43	.00	.40	.53

Table 84

Hierarchical Nonlinear Regression with Maternal Reported EC on the CBQ Predicting Maternal Reported Anxious/Depressed Behavior on the CBCL at 6-month Follow-up

Predictor	β	*t*	*p*	*R*	R^2	ΔR^2	ΔF	*p*
Step 1				.55	.30	.29	24.55	< .001
Age	.10	1.39	.17	-	-	-	-	-
Sex	.03	.43	.67	-	-	-	-	-
Anxious/ Depressed Behavior on CBCL at Baseline	.51	7.31	< .001	-	-	-	-	-
Step 2								
Maternal Reported EC	-.04	-.56	.58	.55	.31	.00	.31	.58
Step 3								
Square of Maternal Reported EC	-.0	-.77	.44	.55	.31	.00	.60	.44

Table 85

Hierarchical Nonlinear Regression with Experimenter Ratings of EC Predicting Maternal Reported Externalizing Behavior on the CBCL at 6-month Follow-up

Predictor	β	t	p	R	R^2	ΔR^2	ΔF	p
Step 1				.59	.35	.35	30.06	< .001
Age	.02	.31	.75	-	-	-	-	-
Sex	-.03	-.50	.62	-	-	-	-	-
Externalizing Behavior on CBCL at Baseline	.59	9.37	< .001	-	-	-	-	-
Step 2								
Experimenter Ratings of EC	-.07	-1.07	.29	.59	.35	.00	1.14	.29
Step 3								
Square of Experimenter Ratings of EC	-.00	-.06	.95	.60	.35	.00	.00	.95

Table 86

Hierarchical Nonlinear Regression with Experimenter Ratings of EC Predicting Maternal Reported Internalizing Behavior on the CBCL at 6-month Follow-up

Predictor	β	*t*	*p*	*R*	R^2	ΔR^2	ΔF	*p*
Step 1				.51	.26	.26	19.93	< .001
Age	.11	1.63	.11	-	-	-	-	-
Sex	.06	.89	.37	-	-	-	-	-
Internalizing Behavior on CBCL at Baseline	.46	6.49	< .001	-	-	-	-	-
Step 2								
Experimenter Ratings of EC	-.05	-.75	.46	.52	.27	.00	.56	.46
Step 3								
Square of Experimenter Ratings of EC	-.00	-.03	.97	.52	.27	.00	.00	.97

Table 87

Hierarchical Nonlinear Regression with Experimenter Ratings of EC Predicting Maternal Reported Attention Problems on the CBCL at 6-month Follow-up

Predictor	β	*t*	*p*	*R*	R^2	ΔR^2	ΔF	*p*
Step 1				.64	.41	.41	38.53	< .001
Age	.03	.56	.58	-	-	-	-	-
Sex	-.06	-1.02	.31	-	-	-	-	-
Attention Problems on CBCL at Baseline	.63	10.54	< .001	-	-	-	-	-
Step 2								
Experimenter Ratings of EC	-.11	-1.67	.10	.65	.42	.01	2.79	.10
Step 3								
Square of Experimenter Ratings of EC	-.07	-1.04	.30	.65	.42	.00	1.08	.30

Table 88

Hierarchical Nonlinear Regression with Experimenter Ratings of EC Predicting Maternal Reported Anxious/Depressed Behavior on the CBCL at 6-month Follow-up

Predictor	β	*t*	*p*	*R*	R^2	ΔR^2	ΔF	*p*
Step 1				.56	.31	.31	24.95	< .001
Age	.10	1.46	.15	-	-	-	-	-
Sex	.03	.49	.63	-	-	-	-	-
Anxious/ Depressed Behavior on CBCL at Baseline	.51	7.35	< .001	-	-	-	-	-
Step 2								
Experimenter Ratings of EC	-.01	-.13	.90	.56	.31	.00	.02	.90
Step 3								
Square of Experimenter Ratings of EC	.01	.11	.91	.56	.31	.00	.01	.91

Table 89

Hierarchical Nonlinear Regression with Global and Performance Ratings of EC Predicting Maternal Reported Externalizing Behavior on the CBCL at 6-month Follow-up

Predictor	β	*t*	*p*	*R*	R^2	ΔR^2	ΔF	*p*
Step 1				.59	.34	.34	28.64	< .001
Age	.03	.51	.61	-	-	-	-	-
Sex	-.04	-.55	.58	-	-	-	-	-
Externalizing Behavior on CBCL at Baseline	.58	9.11	< .001	-	-	-	-	-
Step 2								
Global and Performance Ratings of EC	-.09	-1.39	.17	.59	.35	.01	1.94	.17
Step 3								
Square of Global and Performance Ratings of EC	-.04	-.60	.55	.59	.35	.00	.36	.55

Table 90

Hierarchical Nonlinear Regression with Global and Performance Ratings of EC Predicting Maternal Reported Internalizing Behavior on the CBCL at 6-month Follow-up

Predictor	β	*t*	*p*	*R*	R^2	ΔR^2	ΔF	*p*
Step 1				.51	.26	.26	19.6	< .001
Age	.12	1.62	.10	-	-	-	-	-
Sex	.05	.71	.48	-	-	-	-	-
Internalizing Behavior on CBCL at Baseline	.46	6.44	< .001	-	-	-	-	-
Step 2								
Global and Performance Ratings of EC	-.05	-.71	.48	.52	.27	.00	.51	.48
Step 3								
Square of Global and Performance Ratings of EC	.04	.51	.61	.52	.27	.00	.26	.61

Table 91

Hierarchical Nonlinear Regression with Global and Performance Ratings of EC Predicting Maternal Reported Attention Problems on the CBCL at 6-month Follow-up

Predictor	β	*t*	*p*	*R*	R^2	ΔR^2	ΔF	*p*
Step 1				.63	.40	.40	36.58	< .001
Age	.03	.48	.63	-	-	-	-	-
Sex	-.07	-1.12	.27	-	-	-	-	-
Attention Problems on CBCL at Baseline	.62	10.24	< .001	-	-	-	-	-
Step 2								
Global and Performance Ratings of EC	-.10	-1.54	.13	.64	.41	.01	2.37	.13
Step 3								
Square of Global and Performance Ratings of EC	-.07	-1.12	.27	.64	.41	.01	1.25	.27

Table 92

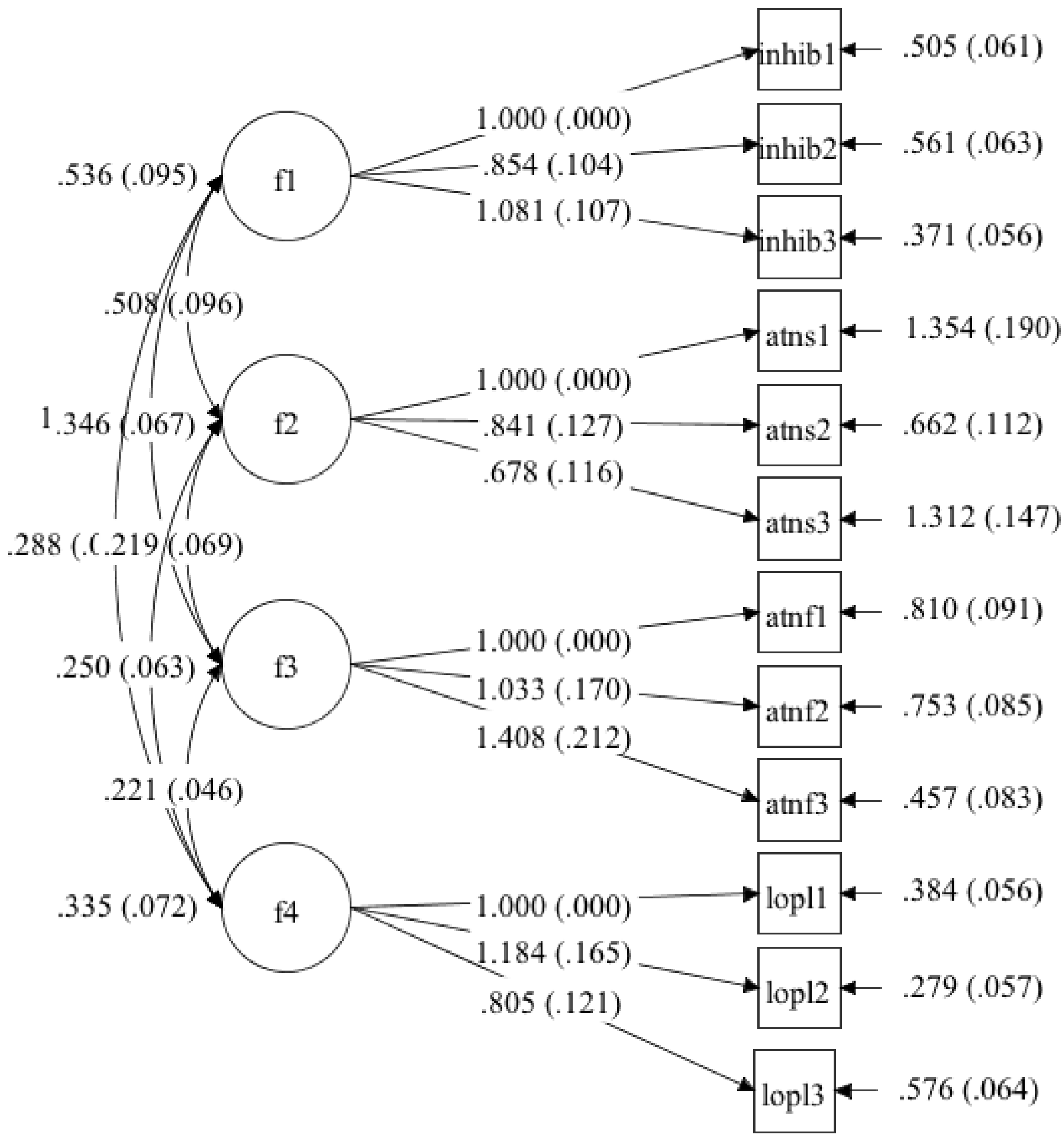
Hierarchical Nonlinear Regression with Global and Performance Ratings of EC Predicting Maternal Reported Anxious/Depressed Behavior on the CBCL at 6-month Follow-up

Predictor	β	*t*	*p*	*R*	R^2	ΔR^2	ΔF	*p*
Step 1				.55	.31	.31	24.22	< .001
Age	.10	1.40	.16	-	-	-	-	-
Sex	.02	.34	.74	-	-	-	-	-
Anxious/ Depressed Behavior on CBCL at Baseline	.51	7.24	< .001	-	-	-	-	-
Step 2								
Global and Performance Ratings of EC	-.06	-.95	.35	.56	.31	.00	.89	.35
Step 3								
Square of Global and Performance Ratings of EC	.01	.20	.85	.56	.31	.00	.04	.85

APPENDIX B: FIGURES

Figure 1

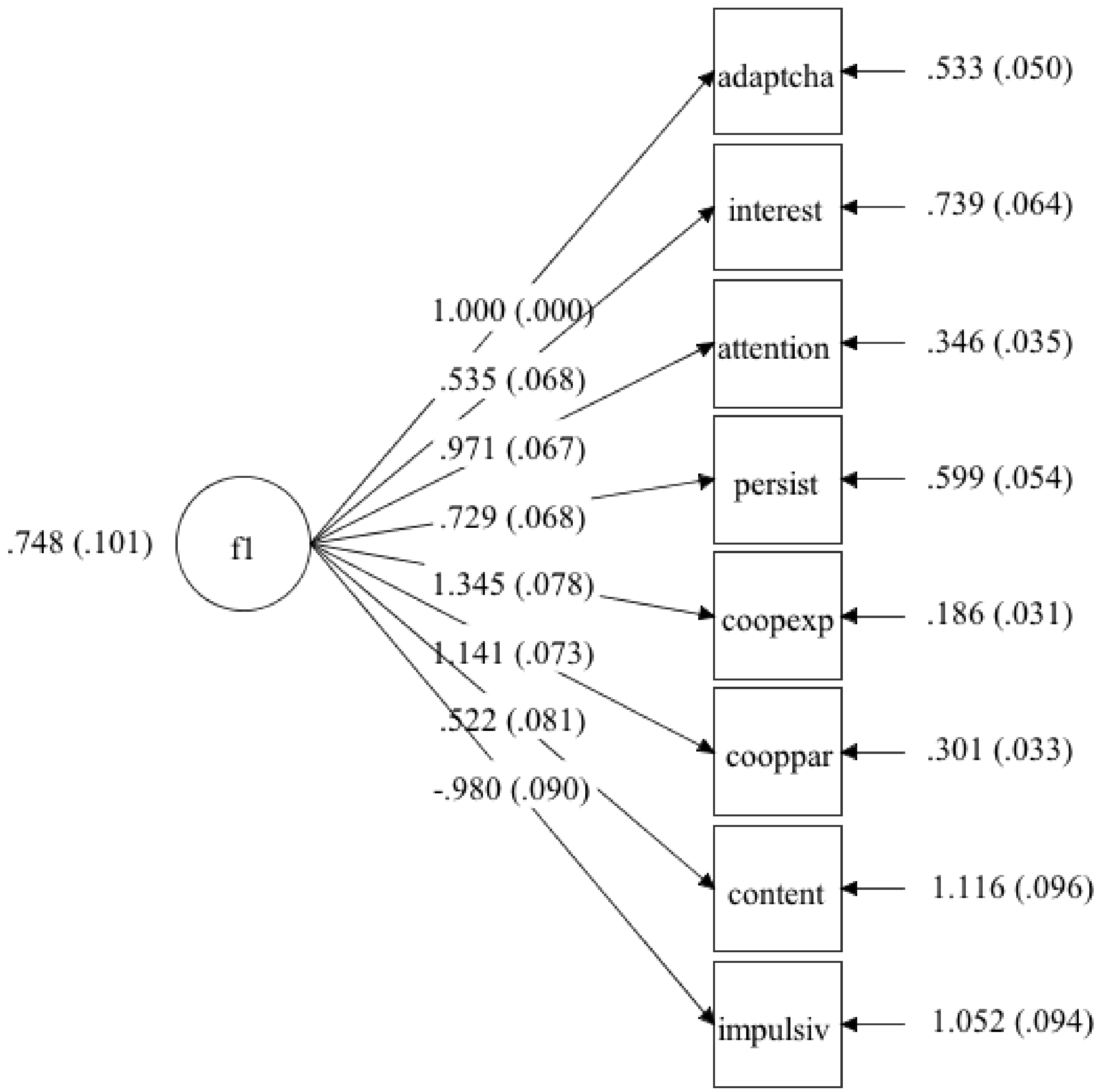
Four Correlated Factor Model of Maternal Reported EC via the CBQ



Note. f1 = Inhibitory Control, f2 = Attentional Shifting, f3 = Attentional Focusing, f4 = Low Intensity Pleasure, inhib1 = inhibitory control parcel 1, inhin2 = inhibitory control parcel 2, inhib3 = inhibitory control parcel 3, atns1 = attentional shifting parcel 1, atns2 = attentional shifting parcel 2, atns3 = attentional shifting parcel 3, atnf1 = attentional focusing parcel 1, atnf2 = attentional focusing parcel 2, atnf3 = attentional focusing parcel 3, lopl1 = low intensity pleasure parcel 1, lopl2 = low intensity pleasure parcel 2, lopl3 = low intensity pleasure parcel 3.

Figure 2

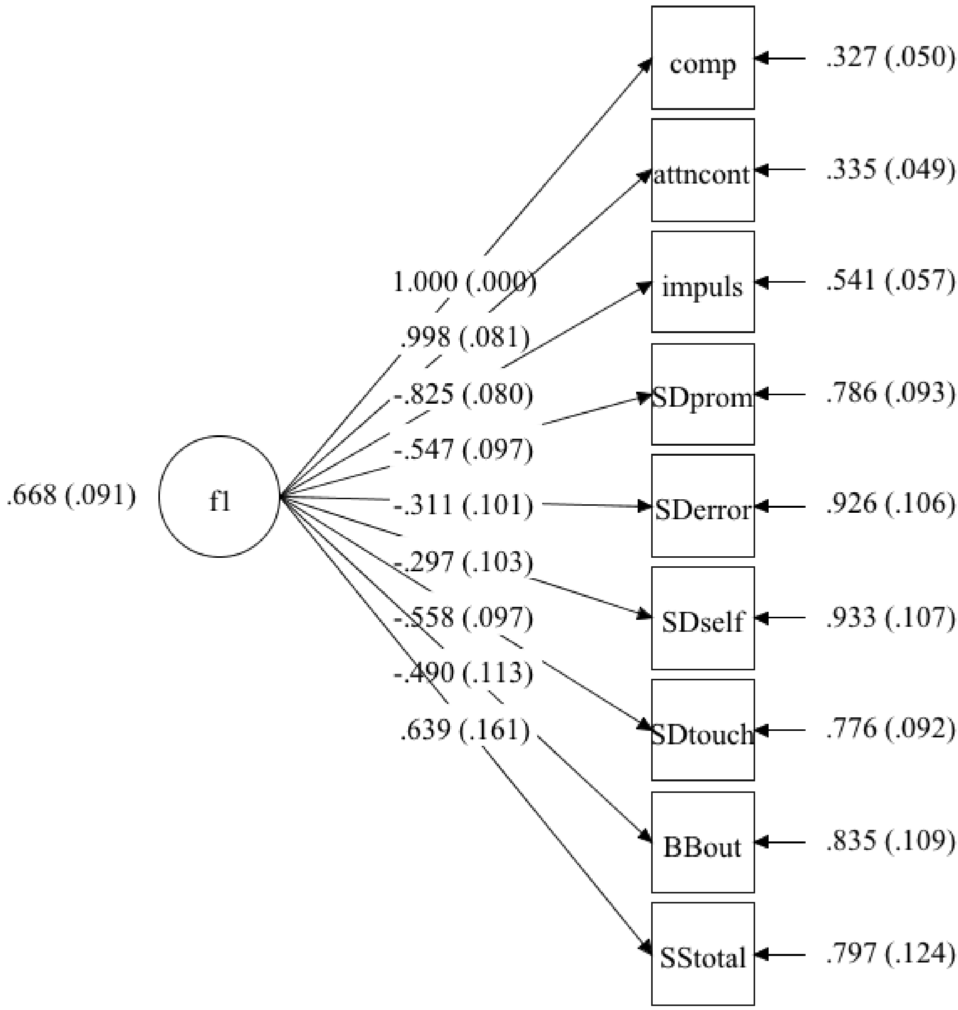
Unidimensional Model of EC Experimenter Ratings Factor



Note. f1 = EC Experimenter Ratings Factor, adaptcha = adaptation to change, interest = interest in test stimuli, attention = attention to tasks, persist = persistence in completing tasks, coopexp = cooperation with experimenter, cooppar = cooperation with parent, content = contentment, impulsiv = impulsivity.

Figure 3

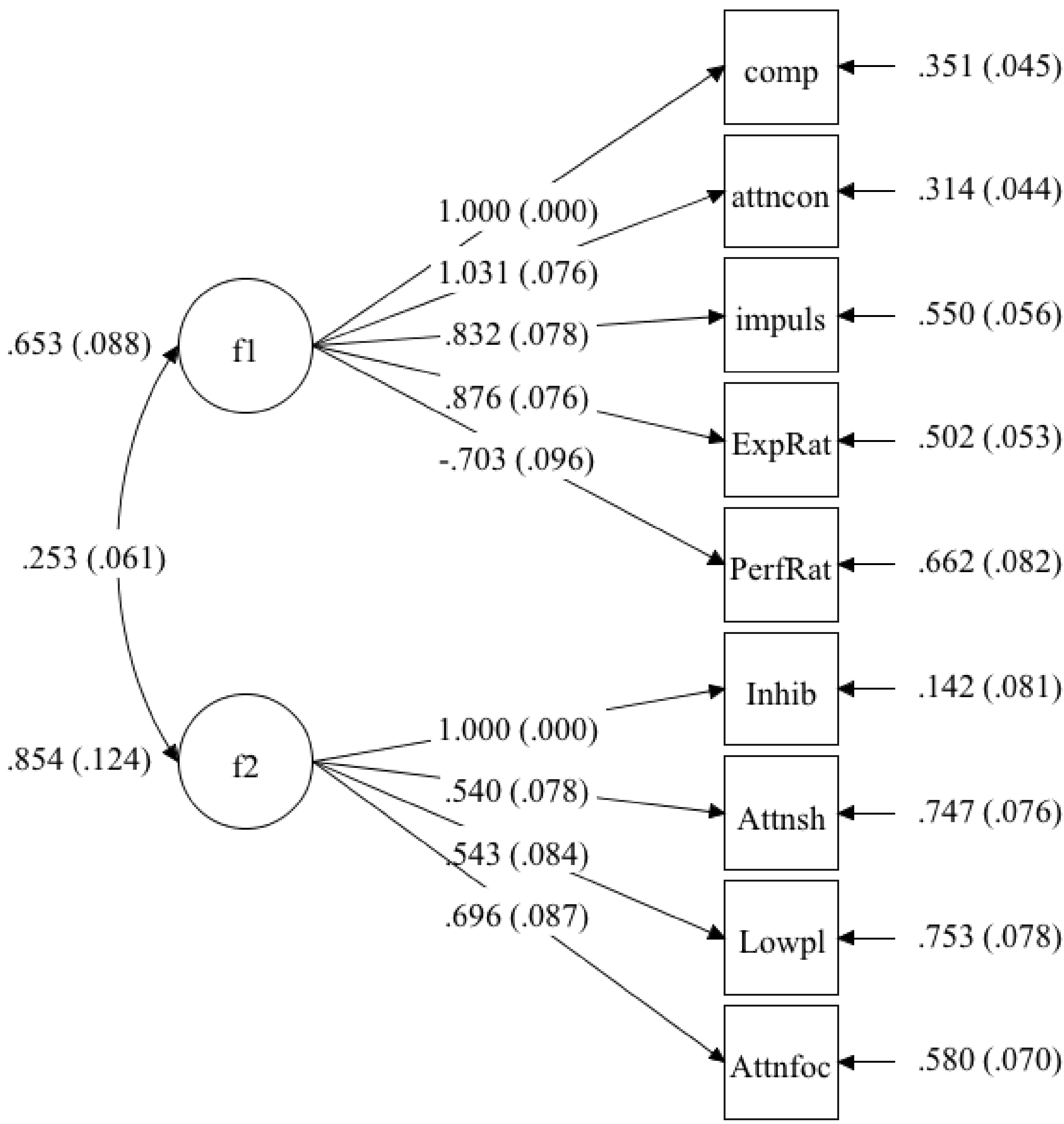
Unidimensional Model of EC Global and Performance Ratings



Note. f1 = EC Global Codes and Performance Measures Factor, comp = Compliance Global Code, attncont = Attentional Control Global Code, impuls = Impulsivity Global Code, SDprom = Number of prompts given in Snack Delay, SDerror = Number of errors made during Snack Delay, SDself = Number of self-corrected errors during Snack Delay, SDtouch = Number of times each child touched the M&M during Snack Delay, BBout = Number of times each child stepped outside of the circle during Balloon Bop, SStotal = Total score during Simon Says.

Figure 4

Correlated Two Factor Model of All EC Factors Examined



Note. f1 = All EC Factors Examined, comp = Compliance Global Code, attncon = Attentional Control Global Code, impuls = Impulsivity Global Code, ExpRat = EC Experimenter Ratings Factor, PerfRat, EC Performance Ratings Factor, Inhib = Maternal CBQ EC Inhibitory Control Factor, Attnsh = Maternal CBQ EC Attentional Shifting Factor, Lowpl = Maternal CBQ EC Low Intensity Pleasure Factor, Attnfoc = Maternal CBQ EC Attentional Focusing Factor.

REFERENCES

REFERENCES

Achenbach, T. M. (1991). *Manual for the Child Behavior Checklist 4-18 and 1991 profile*. Burlington, VT: University of Vermont, Department of Psychology.

Achenbach, T. M., & Edelbrock, C. S. (1983). *Manual for the Child Behavior Checklist and Revised Child Behavior Profile*. Burlington, VT: University of Vermont, Department of Psychiatry.

Ahadi, S.A., Rothbart, M. K., & Ye, R. (1993). Children's temperament in the U.S. and China: Similarities and differences. *European Journal of Personality*, *7*, 359-378. http://dx.doi.org/10.1002/per.2410070506

Allan, N. P., & Lonigan, C. J. (2011). Examining the dimensionality of effortful control in preschool children and its relation to academic and socioeconomic indicators. *Developmental Psychology*, *47*, 905-915. doi:10.1037/a0023748

Anderson, T. W., & Rubin, H. (1956). Statistical inference in factor analysis. *Proceedings of Third Berkley Symposium on Mathematical Statistics and Probability, 5*, 111–150.

Blair, C., & Razza, R. P. (2007). Relating effortful control, executive functioning, and false belief understanding to emerging math and literacy ability in kindergarten. *Child Development*, *78*, 647-663.

Blair, C., Zelazo, P. D., & Greenberg, M. T. (2005). The measurement of executive function in early childhood. *Developmental Neuropsychology*, *28*, 561-571.

Block, J., & Block, J. H. (2006). Venturing a 30-year longitudinal study. *American Psychologist*, *61*(4), 315-327.

Bridgett, D. J., Oddi, K. B., Laake, L. M., Murdock, K. W., Bachmann, M. N. (2013). Integrating and differentiating aspects of self-regulation: Effortful control, executive functioning, and links to negative affectivity. *Emotion*, *13*(1), 47-63.

Carlson, S. M. (2005). Developmentally sensitive measures of executive function in preschool children. *Developmental Neuropsychology*, *28*, 595-616.

Carlson, S. M., & Moses, L. J. (2001). Individual differences in inhibitory control and children's theory of mind. *Child Development*, *72*(4), 1032-1053.

Carlson, S. M., & Wang, T. S. (2007). Inhibitory control and emotion regulation in preschool children. *Cognitive Development*, *22*, 489-510.

Carlson, S. M., Davis, A. C., & Leach, J. G. (2005). Less is more: Executive function and symbolic representation in preschool children. *Psychological science*, *16*, 609-616.

Casalin, S., Luyten, P., Vliegen, N., & Meurs, P. (2012). The structure and stability of temperament from infancy to toddlerhood: A one-year prospective study. *Infant Behavior and Development*, *35*, 94-108.

Caspi, A., & Shiner, R. L. (2006). Personality development. In W. Damon & R. Lerner (Series Eds.) & N. Eisenberg (Vol. Ed.), Handbook of child psychology, Vol. 3. Social, emotional, and personality development (6th ed., pp. 300-365). New York: Wiley.

Chi, T. C., &Hinshaw, S. P. (2002). Mother–child relationships of children with ADHD: The role of maternal depressive symptoms anddepression-related distortions. *Journal of Abnormal Child Psychology*,*30*,387–400. doi:10.1023/A:1015770025043

Cicchetti, D., Ackerman, B. P., & Izard, C. E. (1995). Emotions and emotion regulation in developmental psychopathology. *Development and Psychopathology*, *7*, 1-10. Special Issue.

Comrey, A. L. (1988). Factor-analytic methods of scale development in personality and clinical psychology. *Journal of Consulting and Clinical Psychology, 56,* 754–761.

Dhami, M.K., Hertwig, R., &Hoffrage, U. (2004). The role of representative design in an ecological approach to cognition. *Psychological Bulletin, 130*(6), 959–988. http://dx.doi.org/10.1037/0033-2909.130.6.959

Dennis, T. A., Miller Brotman, L., Huang, K., & Kiely Gouley, K. (2007). Effortful control, social competence, and adjustment problems in children at risk for psychopathology. *Journal of Clinical Child and Adolescent Psychology*, *36*, 442-454.

Dunn, L. M., & Dunn, L. M. (1997). *Peabody Picture Vocabulary Test–III.* Circle Pines, MN: American Guidance Service.

Durbin, C. E. (2010). Modeling temperament risk for depression using developmentally sensitive laboratory paradigms. *Child Development Perspectives*, *4*, 168-173.

Durbin, C. E., Hayden, E. P., Klein, D. N., & Olino, T. M. (2007). Stability of laboratory-assessed temperamental emotionality traits from ages 3 to 7. *Emotion*, *7*, 388-399.

Durbin, C. E., Klein, D. N., Hayden, E. P., Buckley, M. E., & Moerk, K. C. (2005). Temperamental emotionality in preschoolers and parental mood disorders. *Journal of Abnormal Psychology*, *114*, 28-37.

Eisenberg, N., Spinrad, T. L., Eggum, N. D., Silva, K. M., Reiser, M., Hofer, C., . . . Michalik, N. (2010). Relations among maternal socialization, effortful control, and maladjustment in early childhood. *Development and Psychopathology*, *22*, 507-525.

Eisenberg, N., Zhou, Q., Spinrad, T. L., Valiente, C., Fabes, R. A., & Liew, J. (2005). Relations among positive parenting, children's effortful control, and externalizing problems: A three-wave longitudinal study. *Child Development*, *76*, 1055-1071.

Ellis, L. K. (2002). *Individual differences and adolescent psychological development.* Unpublished doctoral dissertation, University of Oregon.

Ellis, L. K., & Rothbart, M. K. (2001). *Revision of the Early Adolescent Temperament Questionnaire.* Poster presenter at the 2001 Biennial Meeting of the Society for Research in Child Development, Minneapolis, Minnesota.

Evans, D. E., & Rothbart, M. K. (2007). Development of a model for adult temperament. *Journal of Research in Personality*, *41*, 868-888.

Fan, J., Flombaum, J. I., McCandliss, B. D., Thomas, K. M., & Posner, M. I. (2003). Cognitive and brain consequences of conflict. *Neuroimage*, *18*, 42-57.

Fan, J., McCandliss, B. D., Fossella, J., Flombaum, J. I., & Posner, M. I. (2005). The activation of attentional networks. *Neuroimage*, *26*, 471-479.

Fan, J., McCandliss, B. D., Sommer, T., Raz, A., & Posner, M. I. (2002). Testing the efficiency and independence of attentional networks. *Journal of Cognitive Neuroscience*, *14*(3), 340-347.

Frye, D., Zelazo, P. D., & Palfai, T. (1995). Theory of mind and rule-based reasoning. *Cognitive Development*, *10*, 483-527.

Gagne, J. R., Van Hulle, C. A., Aksan, N., Essex, M. J., & Goldsmith, H. H. (2011). Deriving childhood temperament measures from emotion-eliciting behavioral episodes: Scale construction and initial validation. *Psychological Assessment*, *23*, 337-353. doi:10.1037/a0021746

Gartstein, M. A., Bridgett, D. J., Dishion, T. J., & Kaufman, N. K. (2009). Depressed mood and maternal report of child behavior problems: Another look at the depression–distortion hypothesis.*Journal of Applied Developmental Psychology*, *30*, 149–160. http://dx.doi.org/10.1016/j.appdev.2008.12.001

Garstein, M. A., & Rothbart, M. K. (2003). Studying infant temperament via the Revised Infant Behavior Questionnaire. *Infant Behavior and Development*, *26*, 64-86.

Gerstadt, C. L., Hong, Y. J., & Diamond, A. (1994). The relationship between cognitive and action: Performance of children 3.5-7 years old on a Stroop-like day-night test. *Cognition*, *53*, 129-153.

Goldsmith, H. H., Reilly, J., Lemery, K. S., Longley, S., & Prescott, A. (1993). Preliminary manual for Preschool Laboratory Temperament Assessment Battery. Madison: University of Wisconsin.

Gorsuch, R. L. (1983). *Factor analysis* (2nd ed.). Hillsdale, NJ: Erlbaum.

Gusdorf, L. M. A., Karreman, A., van Aken, M. A. G., Dekovic, M., & van Tuijl, C. (2011). The structure of effortful control in preschoolers and its relation to externalizing problems. *British Journal of Developmental Psychology*, *29*, 612-634.

Harman, C., Rothbart, M. K., & Posner, M. I. (1997). Distress and attention interactions in early infancy. *Motivation and Emotion*, *21*(1), 27-43.

Hill-Soderlund, A. L., & Braungart-Rieker, J. M. (2008). Early individual differences in temperamental reactivity and regulation: Implications for effortful control in early childhood. *Infant Behavior and Development*, *31*, 386-397.

Hu, L.-T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*, *6*, 1-55.

Hughes, C. (1998). Finding your marbles: Does preschoolers' strategic behavior predict later understanding of mind? *Developmental Psychology*, *34*, 1326-1339.

Izard, C., Dougherty, L., & Hembree, E. (1983). A system for identifying affect expressions by holistic judgments (AFFEX). Newark, DE: Instructional Resources Center, University of Delaware.

John, O. P., Naumann, L. P., & Soto, C. J. (2008). Paradigm shift to the integrative Big Five trait taxonomy: History: measurement, and conceptual issue. In O. P. John, R. W. Robins, & L. A. Pervin (Eds). Handbook of personality: Theory and research (pp. 114-158). New York: Guilford Press.

Johnson, M. H., Posner, M. I., & Rothbart, M. K. (1991). Components of visual orienting in early infancy: Contingency learning, anticipatory looking, and disengaging. *Journal of Cognitive Neuroscience*, *3*(4), 335-344.

Kagan, J., Snidman, N., McManis, M., Woodward, S., & Hardway, C. (2002). One measure, one meaning: Multiple measures, clearer meaning. *Development and Psychopathology*, *14*, 463-475.

Kamradt, J. M., Ullsperger, J. M., & Nikolas, M. A. (2014). Executive function assessment and adult attention-deficit/hyperactivity disorder: Tasks versus ratings on the Barkley deficits in executive functioning scale. *Psychological Assessment*, *26*(4), 1095-1105.

Kieras, J. E., Tobin, R. M., Graziano, W. G., & Rothbart, M. K. (2005). You can't always get what you want: Effortful control and children's responses to undesirable gifts. *Psychological Science*, *16*, 391-396.

Kochanska, G., Barry, R. A., Jimenez, N. B., Hollatz, A. L., & Woodard, J. (2009). Guilt and effortful control: Two mechanisms that prevent disruptive developmental trajectories. *Journal of Personality and Social Psychology*, *97*, 322-333. doi: 10.1037/a0015471

Kochanska, G., Murray, K., & Harlan, E. T. (2000). Effortful control in early childhood: Continuity and change, antecedents, and implications for social development. *Developmental Psychology*, *36*, 220-232. doi: KM037//0O12-1649.36.2.220

Kochanska, G., Murray, K., & Coy, K. C. (1997). Inhibitory control as a contributor to a conscience in childhood: From toddler to early school age. *Child Development*, *68*, 263-277.

Kochanska, G., Murray, K., Jacques, T. Y., Koenig, A. L., & Vandegeest, K. A. (1996). Inhibitory control in young children and its role in emerging internalization. *Child Development*, *67*, 490-507.

Little, T. D., Rhemtulla, M., Gibson, K., & Schoemann, A. M. (2013). Why the items versus parcels controversy needn't be one. *Psychological Methods*, *18*(3), 285-300.

Lo, S., Vroman, L., & Durbin, C.E. (2015). Ecological validity of laboratory assessments of child temperament: Evidence from parent perspectives. *Psychological Assessment*, *27*(1), 280-290.

Lonigan, C. J., Phillips, B. M. (2001). Temperamental influences on the development of anxiety disorders. In M. W. Vasey & M. R. Dadds (Eds.), *The developmental psychopathology of anxiety* (pp. 60-91). New York: Oxford University Press.

Lonigan, C. J., & Vasey, M. W. (2009). Negative affectivity, effortful control, and attention to threat-relevant stimuli. *Journal of Abnormal Child Psychology*, *37*, 387-399.

Majdandzic, M., & van den Boom, D. C. (2007). Multimethod longitudinal assessment of temperament in early childhood. *Journal of Personality*, *75*(1), 121-168.

Manly, T., Anderson, V., Nimmon-Smith, I., Turner, A., Watson, P., & Robertson, I. H. (2001). The differential assessment of children's attention: The Test of Everyday Attention for Children (TEA-Ch), normative sample and ADHD performance. *The Journal of Child Psychology and Psychiatry*, *42*, 1065-1081.

Martel, M. M., & Nigg, J. T. (2006). Child ADHD and personality/temperament traits of reactive and effortful control, resiliency, and emotionality. *Journal of Child Psychology and Psychiatry*, *47*, 1175-183.

Meesters, C., Muris, P., & van Rooijen, B. (2007). Relations of neuroticism and attentional control with symptoms of anxiety and aggression in non-clinical children. *Journal of Psychopathology and Behavioral Assessment*, *29*, 149-158.

Miyake, A., Friedman, N. P., Emerson, M. J., Witzki, A. H., & Howerter, A. (2000). The unity and diversity of executive functions and their contributions to complex "frontal lobe" tasks: A latent variable analysis. *Cognitive Psychology*, *41*, 49-100.

Moriya, J., & Tanno, Y. (2008). Relationships between negative emotionality and attentional control in effortful control. *Personality and Individual Differences*, *44*, 1348-1355. doi:10.1016/j.paid.2007.12.003

Muris, P. (2006). Unique and interactive effects of neuroticism and effortful control on psychopathological symptoms in non-clinical adolescents. *Personality and Individual Differences*, *40*, 1409-1419.

Muris, P., Mayer, B., Reinders, E., & Wesenhagen, C. (2011). Person-related protective and vulnerability factors of psychopathology symptoms in non-clinical adolescents. *Community Mental Health*, *47*, 47-60.

Muris, P., Meesters, C., & Blijlevens, P. (2007). Self-reported reactive and regulative temperament in early adolescence: Relations to internalizing and externalizing problem behavior and "Big Three" personality factors. *Journal of Adolescence*, *30*, 1035-1049. doi:10.1016/j.adolescence.2007.03.003

Muris, P., Meesters, C., & Rompelberg, L. (2006). Attention control in middle childhood: Relations to psychopathological symptoms and threat perception distortions. *Behaviour Research and Therapy*, *45*, 997-1010.

Muris, P., van der Pennen, E., Sigmond, R., & Mayer, B. (2008). Symptoms of anxiety, depression, and aggression in non-clinical children: Relationships with self-report and performance-based measures of attention and effortful control. *Child Psychiatry and Human Development*, *39*, 455-467. doi:10.1007/s10578-008-0101-1

Murphy, B. C., Eisenberg, N., Fabes, R. A., Shepard, S., & Guthrie, I. K. (1999). Consistency and change in children's emotionality and regulation: A longitudinal study. *Merrill-Palmer Quarterly*, *45*, 413-444.

Murray, K. T., & Kochanska, G. (2002). Effortful control: Factor structure and relation to externalizing and internalizing behaviors. *Journal of Abnormal Child Psychology*, *30*, 503-514.

Muthén, L.K. and Muthén, B.O. (2012). *Mplus User's Guide* (7th ed.). Los Angeles, CA: Muthén & Muthén.

Oldehinkel, A. J., Hartman, C. A., de Winter, A. F., Veenstra, R., & Ormel J. (2004).

Temperament profiles associated with internalizing and externalizing problems in preadolescence. *Development and Psychopathology*, *16*, 421-440.

Olson, S. L., Sameroff, A. J., Kerr, D. C. R., Lopez, N. L., & Wellman, H. M. (2005). Developmental foundations of externalizing problems in young children: The role of effortful control. *Development and Psychopathology*, *17*, 25-45. doi:10.10170S0954579405050029

Ormel, J., Oldehinkel, A. J., Ferdinand, R. F., Hartman, C. A., De Winter, A. F., Veenstra, R. . . . Verhulst, F. C. (2005). Internalizing and externalizing problems in adolescence: General and dimension-specific effects of familial loadings and preadolescent temperament traits.

Posner, M. I., & Rothbart, M. K. (1998). Attention, self-regulation and consciousness. *Philosophical Transactions of the Royal Society of London B*, *353*, 1915-1927.

Putnam, S. P., Garstein, M. A., & Rothbart, M. K. (2006). Measurement of the fine-grained aspects of toddler temperament: The Early Childhood Behavior Questionnaire. *Infant Behavior and Development*, *29*, 386-401.

Rosvold, H. E., Mirsky, A. F., Sarason, I., Bransome, E. D., Jr., & Beck, L. H. (1956). A continuous performance test of brain damage. *Journal of Consulting Psychology*, *20*, 343–350.

Rothbart, M. (2004). Temperament and the pursuit of an integrated developmental psychology. *Merrill-Palmer Quarterly*, *50*(4), 492-505.

Rothbart, M. (2007). Temperament, development, and personality. *Current Directions in Psychological Science*, *16*, 207-212. doi:10.1111/j.1467-8721.2007.00505.

Rothbart, M. K., Ahadi, S. A., Hershey, K. L., & Fisher, P. (2001). Investigations of temperament at 3-7 years: The Children's Behavior Questionnaire. *Child Development*, *72*, 1394-1408.

Rothbart, M. K., & Bates, J. E. (1998). Temperament. In W. Damon (Series Ed.), N. Eisenberg (Volume Ed.), *Handbook of child psychology: Vol. 3. Social, emotional, and personality development* (5th ed.). New York: Wiley.

Rothbart, M. K., & Derryberry, D. (1981). Development of individual differences in temperament in early development. In M. E. Lamb & A. I. Brown (Eds.), *Advances in developmental psychology* (Vol. 1, p. 37-86). Hillsdale, NJ: Lawrence Erlbaum Associates.

Rothbart, M. K., Derryberry, D., & Posner, M. I. (1994). A psychobiological approach to the development of temperament. In J. E. Bates & T. D. Wachs (Eds.), *Temperament: Individual differences at the interface of biology and behavior* (pp. 83-116). Washington, DC: American Psychological Association.

Rothbart, M. K., Posner, M. I., Boylan, A. (1990). Regulatory mechanisms in infant development. In J. Enns (Ed.), *The development of attention: Research and theory* (pp. 139-160). Amsterdam, Netherlands: Elsevier.

Rothbart, M. K., Sheese, B. E., & Posner, M. I. (2007). Executive attention and effortful control: Linking temperament, brain networks, and genes. *Child Development Perspectives*, *1*(1) 2-7.

Simonds, J. (2006). *The role of reward sensitivity and response: Execution in childhood extraversion*. Unpublished doctoral dissertation, University of Oregon.

Simonds, J., & Rothbart, M. K. (2004, October). *The Temperament in Middle Childhood Questionnaire (TMCQ): A computerized self-report measure of temperament for ages 7-10*. Poster session presented at the Occasional Temperament Conference, Athens, GA.

Simpson, A., & Riggs, K. J. (2007). Under what conditions do young children have difficulty inhibiting manual actions? *Developmental Psychology*, *43*, 417-428.

Streiner, D. L. (1994). Figuring out factors: The use and misuse of factor analysis. *Canadian Journal of Psychiatry, 39,* 135–140.

Strommen, E. A. (1973). Verbal self-regulation in a children's game: Impulsive errors on "Simon Says." *Society for Research in Child Development*, *44*, 849-853.

Sulik, M. J., Herta, A., Zerr, A. A., Eisenberg, N., Spinrad, T. L., … Di Giunta, L. (2010). The factor structure of effortful control and measurement invariance across ethnicity and sex in a high-risk sample. *Journal of Psychopathology and Behavioral Assessment*, *32*, 8-22. doi:10.1007/s10862-009-9164-y

Tellegen, A. (1985). Structure of mood and personality and their relevance to assessing anxiety, with an emphasis on self-report. In A. H. Tuma & J. D. Maser (Eds.). *Anxiety and the anxiety disorders* (pp. 681-706). Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.

Valiente, C., Eisenberg, N., Smith, C. L., Reiser, M., Fabes, R. A., Losoya, S., . . . Murphy, B. C. (2003). The relations of effortful control and reactive control to children's externalizing problems: a longitudinal assessment. *Journal of Personality*, *71*, 1171-1196.

Verstraeten, K., Vasey, M. W., Claes, L., & Bijttebier, P. (2010). The assessment of effortful control in childhood: Questionnaires and the test of Everyday Attention for children compared. *Personality and Individual Differences*, *48*, 59-65.

Vroman, L., Lo, S., & Durbin, C.E. (2014). Structure and convergent validty of children's temperament traits as assessed by experimenter ratings of child behavior. *Journal of Research in Personality*, *52*, 6-12.

Wechsler D. (2003). *Wechsler Intelligence Scale for Children–Fourth Edition: Technical and*

Interpretive Manual. The Psychological Corporation, San Antonio, TX.

Willoughby, M. T., Blair, C. B., Wirth, R. J., & Greenberg, M. (2012). The measurement of executive function at age 5: Psychometric properties and relationship to academic achievement. *Psychological Assessment*, *24*, 226-239. doi: 10.1037/a0025361

Zelazo, P. D., & Carlson, S. M. (2012). Hot and cool executive function in childhood and adolescence: Development and plasticity. *Child Development Perspectives*, *6*(4), 354-360.

Zelazo, P. D., Muller, U., Frye, D., & Marcovitch, S. (2003). The development of executive function in early childhood. *Monographs of the Society for Research in Child Development, 68*(3), 1-155.

Zhou, Q., Chen, S. H., Main, A. (2012). Commonalities and differences in the research on children's effortful control and executive function: A call for an integrated model of self-regulation. *Child Development Perspectives*, *6*(2), 112-121.