DIFFERENTIATING EXTERNALIZING BEHAVIORS IN EARLY CHILDHOOD: THE ROLE OF NEGATIVE AFFECTIVITY AND ATTENTIONAL CONTROL

Briana Leigh Ermanni

Thesis submitted to the Faculty of the Virginia Polytechnic Institute and State University in partial fulfillment of the requirements for the degree of

Master of Science

In

Psychology

Martha Ann Bell, Chair

Jungmeen Kim-Spoon

Cynthia L. Smith

December 14, 2022

Blacksburg, VA

Keywords: externalizing behaviors, temperament, attentional control, early childhood

Differentiating Externalizing Behaviors in Early Childhood: The Role of Negative Affectivity and Attentional Control

Briana Leigh Ermanni

ABSTRACT

My thesis project aimed to assess potential meaningful differences in the behavioral subtypes of externalizing behaviors in children. Externalizing behaviors are a style of behavioral adjustment that are characteristic of early childhood behavior problems. They are commonly measured in developmental and clinical research using the Externalizing Scale of the Child Behavior Checklist (CBCL). The scale is comprised of Aggressive and Rule-Breaking Behaviors, which are divergent in their developmental trajectory and personological distinctions: aggressive behaviors have emotional underpinnings like frustration, whereas rule-breaking is linked to behavioral impulsivity. In situations of low regulation, negative affectivity may differentially predispose children to these behaviors due to a reactive propensity for anger and frustration. Attentional control can act to regulate these behaviors through shifting and focusing of attention, but may execute this regulation differently based on the situational context. The role of contextual attentional control in predicting two distinct externalizing behaviors has not been sufficiently evaluated in children. AC was behaviorally coded for during a frustrating context. Child behavior problems and temperament were assessed via parent report. Two mediation models were assessed with NA, AC, and aggressive and rule-breaking behaviors, but no indirect effects were found. When individual components of AC were assessed separately as moderations as opposed to mediations, attention shifting played a prominent role and moderated both the aggressive and rule-breaking models. Findings further clarify the role of attention in the relation between temperament and childhood behavior problems.

Differentiating Externalizing Behaviors in Early Childhood: The Role of Negative Affectivity and Attentional Control

Briana Leigh Ermanni

GENERAL AUDIENCE ABSTRACT

Behavior problems in early childhood consist of aggressive and rule-breaking behaviors, which are distinct behaviors with meaningful differences in how they develop. Aggressive behaviors are marked by physical tendencies such as hitting and fighting, whereas rule-breaking behaviors tend to be non-aggressive, consisting of more impulsive behaviors like stealing, cheating, and lying. Negative affectivity in toddlerhood is a predictor of both behaviors, reflecting a heightened predisposition towards negative emotions like anger and frustration. Attentional control is a form of self-regulation, consisting of shifting and focusing attention, that may be responsible for regulating the impact of negative affectivity on each externalizing behavior. Additionally, attentional control in childhood may regulate each behavior differently based on context. The goal of the current study was to understand how negative affectivity predicts each behavior differently through attentional control, specifically based on the context it is measured in. Aggressive behaviors, rule-breaking behaviors, and negative affectivity were measured using parent-report questionnaire, and attentional control was behaviorally coded for during a frustrating puzzle task. Two mediation models were assessed with negative affectivity, attentional control, and aggressive and rule-breaking behaviors, but there were no significant findings. When individual components of attentional control (shifting and focusing) were assessed separately as moderators, attention shifting moderated the relation between negative affectivity and both aggressive and rule-breaking behaviors. Findings further clarify the role of attention in the relation between temperament and childhood behavior problems.

Table of Contents

Introduction

Externalizing behaviors (EBs) are a style of behavioral adjustment commonly seen in early childhood. EBs are comprised of approach-oriented behaviors, typically depicted by physically aggressive tendencies like hitting and fighting with peers, and rule-breaking behaviors such as noncompliance, destruction, and stealing (DeHaan et al., 2012). Antecedents to these behaviors emerge as early as 12 months, and individual differences become stable by 24 months (Hay, 2005). As young children acquire regulation skills and adapt to the developmental and social demands presented in toddlerhood and early childhood, EBs typically begin to decline around the preschool years, and continue to decrease with age (Kahle et al., 2018). Although most children experience normative declines by early childhood, there are a subset who exhibit stable, or even worsening EBs with age. This puts them on a developmental trajectory that has the potential to result in adjustment difficulties in everyday settings at best (Campbell et al., 2010; Hukkelberg et al., 2019), or serious psychopathologies, such as conduct problems or substance abuse disorders at worst (Reef et al., 2011). Specifically, failing to learn regulatory strategies to control such behaviors can hinder adjustment in early childhood, resulting in problems with peers and academic issues stemming from disruptive behavior in school, particularly for those who are more prone to experiencing negative emotions (Coie & Dodge, 1998; Eisenberg & Fabes, 1992; Okano et al., 2020). Conversely, children who mature from early childhood to adolescence with skills that promote adaptive socioemotional development, like strong behavioral and emotion regulation strategies, are likely to successfully adapt to changing environments.

EBs are commonly described as a composite of several behaviors, including aggressive and rule breaking behaviors in early childhood. When considered separately, these specific

behaviors have discrete developmental, personological, and factor analytic distinctions (Burt et al., 2012; DeMarte, 2008; Tackett, 2010; Tremblay, 2010). Aggressive behaviors are naturally characteristic of anger and frustration, and therefore tap into emotional underpinnings, whereas rule breaking behaviors do not tap into the same emotionally laden underpinnings. Instead, they are more characteristic of impulsive behaviors (Tackett, 2010). Dissimilarities in their underpinnings suggest that behavioral and emotional regulation must adapt to different contexts that might predict these behaviors. A lesser explored area of research is how context impacts the way in which regulation is deployed, and how regulation can differentially predict distinct types of EBs. Frustrating contexts are more likely to lead to expression of aggressive behaviors, particularly for children who are prone to negative emotions (Eisenberg & Fabes, 1992). These children may require a mechanism that allows us to first attend to and control emotions. One important source of regulation developing throughout childhood that can be deployed differently based on context is attentional control (Posner & Rothbart, 2000).

My thesis attempted to clarify relations between negative affectivity, contextual attentional control, and two distinct EBs in a community sample of children by asking the following questions: does attentional control in a frustrating context mediate the relation between negative affectivity in toddlerhood and childhood aggressive behaviors? Contrastingly, will attentional control during a frustrating context fail to mediate the relation between negative affectivity and rule breaking behaviors, which do not have the same emotional underpinnings? I will use the rest of this introduction to describe my rationale for the developmental role of negative affectivity and attentional control in delineating these two types of EBs.

The role of negative affectivity in EBs

Differences in how children respond to their environment reflect distinctions in temperament: the constitutionally based individual differences in reactivity and regulation in the domains of affectivity, activity, and attention (Rothbart & Derryberry, 1981). Broadly, the construct is composed of higher-order reactive and self-regulatory dimensions: surgency/extraversion, negative affectivity, and effortful control. Temperament develops early and is relatively stable across toddlerhood and childhood, which is why temperamental predispositions are considered an important foundation for identifying precursors to potential maladaptive behaviors (Putnam et al., 2006; Rothbart & Bates, 2006; Rothbart et al., 2012).

Differing capacities by which toddlers can respond to novel situations illuminate how well a child will adjust to contextual or environmental stressors. For example, low surgent or behaviorally inhibited children display withdrawn and shy behaviors towards novelty, whereas exuberant children are excitable and express greater positive affect, which provides a suitable context for approachability with new peers (Behrendt et al., 2020; Holmboe, 2016; Kochanska & Radke-Yarrow, 1992). On the other hand, children with heightened negative affectivity (NA) are more sensitive to intense negative emotions during frustrating situations (Eisenberg & Fabes, 1992). NA reflects a tendency towards negatively valanced emotions like anger, frustration, and sadness (Rothbart et al., 2007). This sensitivity during frustrating contexts, without proper regulation, is largely mechanistic of aggressive behaviors due to the emphasis on emotion that characterizes aggressive behaviors.

Furthermore, because NA is a reactive trait, children sensitive to negative emotions may also be naturally prone to impulsive rule-breaking behaviors. The construct of NA suggests these behaviors may be closely related to approach motivation, which enhances impulsivity (Rothbart et al., 1994). Children who have difficulties regulating negative emotions and impulsive

behaviors also have difficulty shifting their attention, putting them at greater risk for EBs (Morris et al., 2014). This difficulty in attention shifting is a specific aspect of temperamental attentional control (AC), which may be a critical mechanism in regulating EBs. However, because aggressive behaviors can be elicited during frustrating contexts, but rule-breaking behaviors are more likely to be elicited in contexts that require more behavioral inhibition, AC may regulate these two behaviors differently.

Attentional control as a regulating factor

Executive attention, developing during the toddler years, is one of three distinct neural attention networks that aims to maintain and monitor sensory and internal events (Rothbart et al., 2007). The executive attention network, a form of more effortful regulation compared to alerting and orienting attention systems, is specifically important for regulating temperamental distress (Ruff & Rothbart, 1996). By two years, maturation of the executive attention network underlies efficiency of temperament-based AC (Posner & Rothbart, 2000; Posner & Rothbart, 2013).

AC is comprised of the ability to effortfully shift and focus attention to regulate behavior (Rueda & Checa, 2010), and by ages 4 to 6, better regulated children experience fewer problem behaviors (Sawyer et al., 2015). Additionally, AC is closely associated with regulation of emotions and children who can regulate their attention are more resilient to the effects of stress or stressful situations (Calkins, 2004; Eisenberg et al., 1997). AC is a core component of effortful control, defined as the efficiency of executive attention (Rothbart & Bates, 2006), and is one of the three core temperament constructs that aids in regulating emotions and behavior.

Taken together, AC may act as a mediator of temperament and aggressive behaviors when assessed in frustrating contexts. When emotions arise during these frustrating situations, AC is a foundational mechanism that allows us to effortfully attend to our emotions, and actively choose

a strategy to modulate the emotions, resulting in behavior selection and behavioral control. However, because rule-breaking behaviors are more related to impulsivity than they are to frustration, AC assessed in a specifically frustrating context may not mediate the relation between NA and rule-breaking behavior. Despite evidence of effortful control being documented as a mediator of temperament and behavioral outcomes (Morales et al., 2016; Spinrad et al., 2007), evidence for the role of AC specifically as a mediator in predicting two distinct types of EBs in early childhood is less explored.

Negative affectivity and attentional control

Temperament can be a predictor of later executive attention skills (Ursache et al., 2013). Because NA specifically is a source of temperamental reactivity, it is associated with poorer executive attention (Rueda & Conjero, 2020). As NA develops, it is possible that it increases the saliency of emotional events (Ladouceur et al., 2010), as well as decreases inhibitory control in preschool children (Gerardi-Caulton, 2000) because of its reactive nature. Indeed, NA as reported in toddlerhood via the ECBQ is inversely related to effortful control in early childhood, and importantly, this relation is explained specifically by the negative relations between toddler NA and the attention focusing and inhibitory control scales of the CBQ (Putnam et al., 2008). Thus, individuals who are prone to intense emotions are expected to be higher in EBs, particularly when regulatory skills are low (Eisenberg & Fabes, 1992). Additionally, in attention bias literature, research in infancy highlights how infants low in NA are quicker to fixate on a probe after attending to an angry in the face Baby Dot Probe Task (Perez-Edgar et al., 2017), meaning infants might not be as sensitive to emotional contexts when they are low in NA. Together, temperamental predispositions towards negative emotions can impact development of AC, which in turn can influence development of specific EBs.

Two pathways for attentional control in predicting externalizing behaviors

EBs are commonly categorized into a single composite variable, specifically in the developmental and clinical literature. However, EBs are multidimensional in nature with several different behaviors contributing to the construct. They are generally combined into one scale because of the comorbidity of the major contributing behaviors (Yang et al., 2001). The Child Behavior Checklist 6-18 (Achenbach & Rescorla, 2001) is a widely used questionnaire to assess social and behavioral adjustment. Problem behavior is loaded onto two scales: the internalizing and externalizing scale, where the externalizing scale is often used as a broad measure of behavioral maladjustment. Efforts to create empirically based syndromes that can be utilized by both clinicians and researchers caused the need to distinguish between aggressive and non-aggressive behavior problems (Achenbach & Rescorla, 2004). This resulted in the externalizing scale being comprised of rule breaking and aggressive behavior syndromes. Although these behaviors are typically correlated and co-occurring, they also represent distinct behaviors that follow different developmental trajectories (DeHaan et al., 2012). Combining rule-breaking and aggressive behaviors into a composite variable ignores the fact that each behavior is a byproduct of different contexts. For example, childhood aggression comes in the form of physical and relational components, whereas rule-breaking acts tend to consist of more impulsive covert behaviors like lying and cheating (DeHaan et al., 2012). Therefore, when regulating these distinct EBs, AC may regulate differently based on the context in which it is being utilized.

Efforts to distinguish between the etiologies of aggressive behaviors and rule-breaking behaviors have resulted in findings that different types of emotion dysregulation can account for variability between the behaviors (Burt, 2009). Aggressive behaviors in childhood can be accompanied by outbursts of anger, followed by physical acts such as hitting in response to that

anger. Regulating this emotion begins with an ability to attend to one's own emotional state, resulting in strategies to address the emotion and control the resultant behavior in a more socially acceptable way. Thus, emotion and affect dysregulation may precipitate the development and maintenance of aggressive behaviors (Frick et al., 2017; Verona et al., 2002). Regulating emotional reactivity in frustrating situations by allocating attention mechanisms accordingly results in a more even-toned response to the frustration (Eisenberg et al., 1997).

This type of AC (i.e., allocating attention to emotions in a frustrating situation) is not as effective in contexts where rule-breaking behaviors may occur. Again, rule-breaking behaviors consist of more covert behaviors like running away from home, lying, and stealing, all of which may have underlying impulsive tendencies. AC in this context allows the child to monitor their behavior given a specific situation and appropriately inhibit the behavior. To inhibit an inappropriate behavior, a child must first be able to adequately attend to the situation at hand and internalize the socially acceptable rules, as well as their own goals. This type of AC relies less on emotion regulation and instead, places more emphasis on behavioral regulation. The short-term goal of alleviating distress, whether it be by lying about a behavior or stealing an object that is heavily desire but unobtainable, may be take precedence over behavioral control (Tice et al., 2001). In these cases, AC during a frustrating context would not mediate the relation between NA and rule-breaking behaviors because the AC context does not match the behavioral outcome.

The current study

Given the stability of EBs once they are established, despite differing trajectories, it is important to identify the early intrinsic factors that contribute to their development. Current research identifies relations between temperament and EBs by utilizing the broad externalizing scale of the CBCL, despite the distinct etiologies of the two major externalizing subscales.

Research that does attempt to differentiate developmental pathways of aggressive and rule-breaking behavior has largely focused on early to late adolescent populations (Becht et al., 2016; Eley et al., 2003; Niv et al., 2013). Additionally, while the larger regulatory construct of effortful control has been assessed as a mediator of various types of behaviors (Bater & Jordan, 2017; Belsky et al., 2007; Morrison & Heimberg, 2013; Valiente et al., 2006), fewer studies have assessed the specific role of AC with the deconstructed externalizing scale behaviors of aggressive and rule breaking behaviors. Therefore, the purpose of my thesis was to assess the importance of AC as a mechanism linking toddler NA and the externalizing subtypes in a younger population, and to highlight the specific importance of context in determining how AC regulates different behaviors. To do so, AC was behaviorally coded during a frustrating puzzle task. Specifically, the current study had two aims: first, a mediation model was analyzed where AC acted as a mediator between toddler NA and early childhood aggressive behaviors. I hypothesized AC in a frustrating context would mediate the relation between NA and AGG (aggressive behaviors) such that greater NA would predict less AC, and less AC during a specifically frustrating context would produce more AGG (H1). The second aim focuses on emphasizing the importance of context in regulating specific kinds of behavior, and a second mediation analysis was assessed between NA, AC in a frustrating context, and RBB (rule-breaking behaviors). I hypothesized that, unlike AGG, RBB do not tap into the same emotional underpinnings, so AC would not mediate the relation between NA and RBB.

Methods

Participants

This community sample includes a subset of children who visited our lab as part of a larger longitudinal study of the integration of cognition and emotion across early development

(the "CAP Study"). Children were recruited from two sites, Blacksburg, Virginia, and Greensboro, North Carolina, using mailing lists, flyers, media advertisements, and word of mouth. The participants used in the current study (n = 304) represent two cohorts of the larger sample. Because the first cohort (approximately 25% of the sample; n = 106) did not have a lab visit at age 6 due to the funding schedule, those participants were removed from behavioral coding and subsequent analyses. In determining the number of participants available for coding and analysis from the original sample, those who did not contribute either questionnaire outcome, Aggressive Behaviors/Rule-Breaking Behaviors, from the CBCL at age 6 were removed. This resulted in a final sample size for the current study of 230 children (116 females), of which 215 contributed NA data at age 2, and 179 contributed usable data for the Puzzle task at age 4. NA data and puzzle tasks were missing due to the puzzle task ending early, disqualifying the task from being included for analysis, families not returning for a lab visit, or families not returning questionnaires. Ethnic and racial composition for the reduced sample was representative of the regions in which they were recruited (8.7% Hispanic; 74.8% Caucasian). Little's algorithm for testing MCAR was employed and was not significant, $x^2(9) = 15.35$, $p = 0.08$, implying missing data is not systematic (Rhemtulla & Little, 2012). Furthermore, independent samples t-tests revealed that non-contributing families at both age 2 and age 4 did not differ significantly than contributing families in terms of child sex, race, or if they contributed age 6 CBCL data. Age 2 NA was different between contributors (M = 3.06) and non-contributors (M = 3.37).

Procedures

Upon arrival for their 2-, 4-, and 6-year visit to the lab, mother and child were greeted by a research assistant who collected informed consent. Research assistants from each location were

trained on identical protocols and administered a battery of cognitive, socioemotional, and mother-child interaction tasks to participants at each visit. Prior to each visit, mothers were mailed a set of questionnaires that included a demographic and temperament questionnaire. They were asked to bring the completed questionnaires with them to each lab visit. Tasks were video recorded for later behavioral and reliability coding. Only the tasks and questionnaires used in the current study are described.

Measures

Negative Affectivity at 2 years

Prior to their visit to the laboratory, mothers completed the Early Childhood Behavior Questionnaire (ECBQ; Putnam et al., 2006), which assess 18 different domains of temperament in children between 1.5- and 3-years-old. Mothers are asked to report on the frequency of specific behaviors during commonly occurring contexts (e.g., "When playing outdoors," "When told no") using a 7-point Likert scale format. Responses range from "never" to "always." The Negative Affectivity (NA) factor is created by averaging discomfort, fear, sadness, reversed soothability, motor activation, perceptual sensitivity, and shyness subscales (Putnam et al., 2006). In the current sample, Cronbach's alpha for the NA factor is 0.91.

Attentional Control at 4 years

AC was behaviorally coded from recordings of lab visits during a frustrating puzzle task. Mothers and children participated in three puzzle tasks throughout the duration of the original study protocol. Prior to the frustrating puzzle task, mothers and children were instructed to complete two sets of age-appropriate puzzles together. The third puzzle task, which is the task utilized in this study, is different in that it was designed to elicit frustration by requiring children to complete a more difficult, not age-appropriate, puzzle without the mother's help. Children

were seated at a small table with the puzzle laid out before them. The mother was instructed not to interact with the child and instead sit to the side of the table and read a magazine or work on questionnaires. The experimenter explained the rules to the child and then, depending on data collection site, moved to the corner of the room to "work on a task" of their own, or left the room. The frustrating puzzle task lasted approximately 2 minutes. Reliability coding was conducted for 20% of the sample (36 videos) and interrater reliability among coders was excellent (ICC = .94).

Behavioral coding. Over the course of the summer of 2022, three undergraduates were trained on an AC coding scheme that was adapted from a continuous behavior coding scheme originally used by the lab (Bell et al., 2019). The coding scheme can be found in Appendix A. AC behaviors of interest were originally derived from the Attention Shifting and Attention Focusing scales of the ECBQ, and the Attentional Focusing scale of CBQ (Putnam et al., 2001) given their substantial overlap. Once training began, AC behaviors were eventually simplified to include two codes that were adapted to fit the nature of children's natural attention behavior:

Focused Attention (FA) behaviors were coded to include instances when the child was actively focusing on the task: placing puzzle pieces and working by themselves. Given the dynamic nature of preschool aged children working on difficult tasks, FA codes included instances when the child was talking to themselves or to the parent, as long they were focusing attention on a puzzle piece or the puzzle board. On many occasions, the children would express their frustration towards the task (e.g., "I don't want to/don't know how to do this). If the child continued to focus attention towards the puzzle piece or puzzle board, the behavior is still coded as FA.

Off Task (O) behaviors were all behaviors that were not coded as FA. This includes instances where the child breaks focus with the task to deploy their attention elsewhere. To improve consistency among the coders, a four second rule was developed so that the child needed to break attention from the task for four seconds or longer for the behavior to be considered O. Any behavior that deviated from FA for less than four seconds was determined not to be substantial enough to be considered O. For example, a child may quickly show parent a puzzle piece and immediately go back to the task. O was also coded for when the child would break attention from the task to ask parent for help (regardless of timing), would leave the table altogether, or would start an unrelated conversation with parent or experimenter without focusing attention on the task.

Behavioral coding was conducted in Datavyu (v. 1.5.3), an open-source video coding and data visualization tool. Processing of behavioral and reliability coding was conducted in R Studio (v. 1.4.1103). Shifting scores (SHF) for a participant were created in R Studio by calculating how many shifts occurred between FA codes and O codes. To create an AC composite, SHF behaviors (0-7) were reverse scored to match the direction of the FA variable, where a greater proportion signifies more time spent focusing attention on the task. Both FA and the reverse scored SHF variable were z-scored, and then averaged to create the AC variable.

EBs at 6 years

Parents reported on their child at 6 years of age using the Child Behavior Checklist 6-18 (Achenbach & Rescorla, 2001), which reports on a variety of emotional and behavioral problems. It is scored on a 0 (not true) to 2 (very true) scale. The questionnaire contains 113 items about common problems such as emotional reactivity, somatic complaints, aggressive behavior, and attention problems. The CBCL 6-18 loads problem behavior onto two broad

scales, Internalizing and Externalizing. The Externalizing scale summarizes the Rule-Breaking and Aggressive Behaviors scales. In this study, the Cronbach's alpha of the broad Externalizing scale at age 6 is 0.89 but the scale was separated into its two subscales to reflect two different EBs in my analyses. The Rule-Breaking scale consists of 17 items with a Cronbach's alpha of 0.62. See Table 1 for means of individual items on the rule-breaking scale. The Aggressive Behaviors scale consists of 18 items and has a Cronbach's alpha of 0.89. See Table 2 for means of individual items on the aggressive behaviors scale. Individual means for both scales are low, which is expected from a community sample of children. Aggressive behavior and Rule-Breaking T-scores, which have been normed for sex and age, are used in this study.

Covariates

Age 4 Externalizing behavior was added as a covariate to account for previous behavior problems. The rule-breaking subscale does not emerge in the CBCL until age 6, which is why the full externalizing scale at age 4 was used as a covariate. Including the full externalizing scale at age 4 additionally accounts for attention problems, which allows for assessment of more distinct behaviorally coded attention.

Data Analysis Strategy and Missing Data

Missing data were handled using multiple imputation, which is an appropriate technique for data that is MCAR and MAR (van Ginkel et al., 2020). The number of imputations was set to 20, based on roughly 20% missing data among the study variables (White et al., 2011). Imputed datasets were then aggregated to be used for analyses. Descriptive statistics from the imputed dataset (n = 230; Table 3) was compared to listwise deletion dataset (n = 163; Table 4) to evaluate any bias that may have been introduced due to the imputation method. Direction of

correlations and slopes were similar. Therefore, final models presented in this document reflect analyses using the imputed dataset.

Descriptive statistics were analyzed using IBM SPSS (Version 28) and mediation analyses were conducted using PROCESS Macro v.4.0. Indirect effects were tested using 95% confidence intervals derived using bootstrap samples (10,000 draws) (Hayes, 2021). If the 95% confidence intervals include zero, the indirect effect is not significant and full mediation is not present. A power analysis was conducted in G*Power (v. 3.1) with effect size parameter set to 0.15 (medium effect size), alpha error probability to 0.05, and power to 0.95. With only two predictors in the hypothesized analyses (NA and a mediator, AC) included, the current sample is well powered.

Results

Preliminary Data Analysis

Prior to imputation and analyses, data was assessed for normality (skew ≤ 3 and kurtosis ≤ 10; Kline, 2011). Outliers for all variables were handled by winsorization so that scores ± 3 SD of the mean were replaced by the next closest score that was within ± 3 SD. This technique was applied to fourteen cases 3 SD above the mean: one for NA, seven for rule-breaking, and six for aggressive behaviors.

Bivariate Correlations

Correlations among the variables of interest are depicted in Table 5. As predicted, age 4 Externalizing behaviors were positively related to both age 6 Rule Breaking and Aggressive behaviors ($r = .47$, $p < .001$; $r = .56$, $p < .001$). NA was correlated to both Rule Breaking and Aggressive behaviors ($r = .14$, $p = .03$; $r = .21$, $p < .001$), signifying toddlers whose mothers

reported as higher in NA experienced more problem behaviors as children. FA was negatively related to both SHF behaviors (r = -.30, p <.001) and toddler NA (r = -.14, p = .03).

Mediation Analyses

Regression analyses were used to assess the mechanistic role of preschool AC in the association between toddler NA and age 6 EBs. The 95% bootstrap confidence intervals were used to estimate indirect paths for both hypothesized models. Figure 1 and 2 depicts the hypothesized models with standardized coefficients. The first hypothesis, AC would mediate the relation between toddler NA and childhood AGG, was assessed first. NA was not a significant predictor of AC (Path A; B = -.06, p = .25), and continued to be an insignificant predictor of AGG (Path C'; B = .08, p = .83) after controlling AC as a mediator (Path B; B = .22; p = .61). Because all paths were insignificant, the indirect effect was found to be insignificant (B = -.01, BootSE = .04, 95% CI: [-0.11, 0.06]). Support was found for the second hypothesis: AC would not mediate the relation between toddler NA and childhood RBB. Again, no paths were significant predictors, resulting in an insignificant indirect effect (B = -.15, BootSE = .04, 95% CI: [-0.12, .03]). Findings illustrate that AC, when composed of both focusing and shifting behavior, is not a mechanism through which toddler NA would predict early childhood AGG or RBB.

Post-Hoc Analyses

Mediation analyses only partially supported the main hypotheses of this thesis. Because temperamental AC is composed of both shifting and focusing behaviors, additional analyses were run to assess any potential relations between individual components of AC, NA, and each outcome variable. Based on empirical studies analyzing attention focusing and shifting separately, it could be hypothesized that separate components of AC play more prominent roles

in predicting different types of behavior outcomes, as they may represent different cognitive processes (Hassan et al., 2020; Morris et al., 2014; Posner et al., 1987).

The following post-hoc analyses includes four mediation models exploring both FA and SHF behaviors as mediators, four moderation analyses exploring both FA and SHF as moderators, and two AC moderation models. No specific hypotheses were formulated prior to the following analyses given their exploratory nature in this thesis.

Focused Attention and Shifting Mediation Models

FA was explored as a potential mediator for both AGG and RBB models using unstandardized variables. In the AGG model, NA was a significant predictor of FA (Path A; b = -.07, p = .04). While NA became insignificant when controlling for the mediator (Path C'; b = .11, p = .87), FA was not a significant predictor of AGG (Path B; b = -.15, p = .92). Therefore, 95% CIs revealed an insignificant indirect effect (b = .01, BootSE = .11, 95% CI: [-0.21, 0.26]).

Similar results were found for the RBB model. NA continued to be a significant predictor of FA (Path A; b = -.07, p = .04), and when controlling for FA as a mediator, it became insignificant (Path C'; b = -.26, p = .67). However, FA did not reach significance when predicting RBB (Path B; b = .90, p = .46), and no indirect effect was found (b = -.06, BootSE = .10, 95% CI: [-0.32, 0.09]).

SHF behaviors (prior to reverse scoring) were then explored as a potential mediator for both AGG and RBB models using unstandardized variables. No significant paths were identified for either model, and therefore, results were not reported in this section.

Focused Attention and Shifting Moderation models

The above analyses reveal that AC components of FA and SHF in this sample did not play a mechanistic role between NA, AGG, and RBB. To explore potential interaction effects of

individual AC components, NA, and both AGG and RBB, the first moderation analysis was conducted with NA (centered) as the predictor, FA (centered) as the moderator, and AGG as the outcome. The second moderation analysis included RBB as the outcome. Neither model produced any main or interaction effects, and specific results are not reported.

When SHF behaviors (centered, prior to reverse scoring) were included as a moderator in the third moderation analysis with AGG as the outcome, interaction effects were found (Table 6). Simple slopes analysis at one SD above and below the mean revealed that toddlers higher in NA developed fewer AGG, only for children who displayed more shifting behaviors during the puzzle task (b = -.96, p = .02; Figure 3). Specifically, the Johnson-Neyman technique revealed that after centering, NA predicted fewer AGG behaviors for children with more than 2.5 shifts. Additionally, when added as a moderator in the RBB model, no main effects were found, but an interaction was revealed (b = -1.02, p = .00; Table 7). Again, only for children high in SHF behaviors did NA predict fewer RBB (Figure 4). The Johnson-Neyman technique revealed that after centering, NA predicted fewer RBB behaviors for children with more than 0.69 shifts.

Attentional Control Composite Moderation Models

Based on above findings, AC as a composite was assessed as a moderator as opposed to a mechanism. The AC variable was previously standardized for use in the original hypothesized mediation analyses. Therefore, NA was standardized to match the scale of AC in the following analyses, and standardized results are presented. The first moderation analysis included AC as a moderator between NA and AGG. No significant main or interaction effects were found. In the RBB model, no main effects were found. However, while controlling for previous behavior problems, there was a significant interaction between NA and AC (B = .98, p = .01; Table 8). Simple slopes analysis at one SD above and below the mean revealed that toddlers reported as

being higher in NA developed fewer RBB in early childhood, but only for those who displayed less AC abilities during the puzzle task (Figure 5). However, given the results from the SHF models, it's possible that this interaction is driven by the SHF variable.

Discussion

EBs in the early childhood period are commonly measured using parent-report and are composited into one scale with AGG and RBB (CBCL 6-18; Achenbach & Rescorla, 2001)**.** This composite ignores the fact that these behaviors are discrete, follow different developmental trajectories, and can arise out of slightly different contexts (Burt et al., 2012)**.** Therefore, how each behavior is regulated may depend on the context regulation in which it is being utilized, as well as how temperamental predispositions are impacting regulation development. The current thesis study sought to clarify the role of AC in the relation between NA, AGG, and RBB. Furthermore, the study also sought to highlight the importance of context when considering these relations. AC was behaviorally coded for during a frustrating context to model the affective dysfunction commonly underlying aggressive behaviors (Burt & Donnellan, 2008).

I had hypothesized that AC, expressed as a composite of SHF and FA behaviors, would mediate the relation between NA in toddlerhood and AGG in childhood. Specifically, to highlight the importance of AC in early childhood as a regulatory mechanism, I hypothesized greater toddler NA would predict greater AGG through less AC during a frustrating task, but that AC would not mediate the relation between NA and RBB. Predictions were theoretically motivated by the documented relations between NA, EC, and the broad EB composite. However, contrary to the first hypothesis, but in support of the second, no evidence of mediation was found in either model.

The goal of post hoc analyses in this study was now to assess any potential pathways for AC to mediate relations between NA and AGG or RBB, despite the original hypothesis that AC as a composite would not mediate the relation between NA and RBB. Individual components of AC, shifting and focusing, may play different roles in regulating behavior given they may stem from differing cognitive processes (Miller et al., 2013). However, again, no indirect effects were found to be significant. It's possible that AC and individual components of AC are not strong enough mechanisms by themselves to provoke change in behaviors, which is why the literature commonly suggests effortful control as a mediator of behavior problems. Attention by itself is not a suitable mechanism to manage either behavior, but instead may be more critical for impacting higher-order cognitive abilities at earlier ages (Whedon et al., 2016). Age could be an additional important factor as to why mediation analyses did not produce results in this specific study. Six-year-old children are just entering elementary school, and even though the CBCL is considered appropriate for assessing behavior problems from ages 6 to 18 years, it is possible that real distinctions in the AGG and RBB subscales won't be observed until later ages (e.g., pre-adolescence or adolescence).

Both individual components of AC and AC as a composite have not provided evidence of playing a mechanistic role in this study. Thus, moderator relations were explored. For both behaviors, high toddler NA predicted fewer behavior problems but only for children who displayed a greater number of shifts during the task prior to reverse scoring. The finding with the AGG outcome is consistent with studies that have assessed individual components of AC. Attention shifting is widely described as an early developing regulation strategy that persists across developmental periods (Eigsti et al., 2006; Todd et al., 2012). As early as 4 months, infants can begin to flexibly engage and disengage from locations and stimuli, resulting in lower

negative emotionality and greater soothability (Johnson et al., 1991). Shifting attention away from distressing stimuli is related to fewer externalizing behaviors and is particularly difficult for children who display aggressive behaviors (Wilson, 2003), and children at risk for ADHD display fewer SHF behaviors (Auerbach et al., 2008).

Greater attention shifting as a moderator of NA and RBB is an unexpected finding. Because of the distinctions between AGG and RBB, shifting attention may play significant but different roles for each behavior. Because RBB are reflective of impulsive tendencies, greater shifts in attention would demonstrate an inability to regulate attention in children with heightened negative emotionality, resulting in more, not less, RBB. Additionally, because NA is a reactive temperament trait, I had hypothesized that it would be related to RBB. However, no correlations or main effects of NA, SHF, and RBB were found in this study. Consistent with this, in a review article of the heterogeneity within different forms of conduct disorders, Klahr and Burt (2014) found that while RBB was robustly associated with impulsivity, NA was largely associated with AGG and displayed little to no relation with RBB.

The task in this study was particularly frustrating by design. Children who were predisposed to negative emotionality already might have found the task specifically frustrating, and they utilized greater shifts away from the task to alleviate their distress. Thus, children high in NA were reported to have fewer behaviors problems overall when they utilized SHF behaviors. This potentially explains the robust findings with attentional shifting, but not FA. When AC as a composite was explored as a moderator, a significant relation was found, although in the opposite direction: toddlers with greater NA were reported as having fewer RBB when they displayed fewer shifting behaviors. This contrasts with the effortful control literature, as well as the attention literature that describes greater EC and more shifting behaviors as buffering factors.

However, given the findings from the attention shifting models, it's possible that SHF plays a more prominent role in regulating externalizing behaviors, and thus is driving the AC moderation. Interestingly, the AC composite did not moderate the relations between NA and aggressive behaviors, but again, these results should be interpreted with caution given the potential driving effects of the attention shifting variable within the AC composite.

Despite the alternative rationale discussed above, in addition to the AC moderation, the SHF moderation findings should be interpreted with caution as well. Even though the unstandardized and significance levels of the SHF interaction effects are meaningful in size, it's important to emphasize there are no main effects in either the RBB or AGG moderation analysis. Additionally, SHF behaviors are not correlated with either NA or either outcome of interest, while NA was not predictive of either outcome of interest, despite being correlated with both. Taken together, interpretation of the interaction effect at high and low levels of NA becomes difficult and less meaningful because there is no overall effect of either NA or SHF, only when considered as an interaction. There are two potential reasons for this lack of relations, the first being the way in which attention shifting was coded. Coding O (off-task) as any behavior that is not the child focusing on the puzzle was meant to be operationalized as task oriented focused attention, meaning when attention is not geared towards the task, it is not task oriented attention. However, coding the behavior in this way could be an oversimplification, therefore resulting in a shift code that is not representative of the actual behavior of attention shifting. Regarding the surprising lack of main effects between NA and either behavioral outcome, NA in toddlerhood is often found to be predictive of various psychopathologies in early childhood, albeit weak effect sizes (Kostyrka-Allchorne et al., 2020). Results from the meta-analysis conducted by Kostyrka-Allchorne and colleagues suggest that the heterogeneity of traits included in the NA construct

(e.g., fear, sadness, anger) prevent us from identifying specific pathways through which negative emotionality can predict different outcomes. This may lend insight as to why the broad construct of NA failed to associate with the deconstructed externalizing behaviors.

Other significant limitations to consider is that the sample is a community sample of children. These children are relatively well regulated and there is little variance in the RBB scale. Additionally, the RBB scale itself asks questions that may not be representative of the earlier age range of the scale, 6-year-olds (see Table 1). The scale asks questions such as "Thinks about sex too much" and "Uses drugs for nonmedical purposes." Perhaps this explains the limited variability reflected in the scale, which may be responsible for the lack of any mediation results in the analyses. Additionally, parent-report measures were used to assess temperament and child behavior problems, which runs the risk of subjective reporting. However, both measures (ECBQ, CBCL) are widely used and valid indices of temperament and behavior problems (Achenbach & Rescorla, 2001; Berubé & Achenbach, 2010; Putnam et al., 2006; Putnam et al., 2008). Despite these limitations, AC was behaviorally coded during a context specific task, which is a novel contribution. Children's AC is commonly assessed using computer-based paradigms and parent-report measures, which are methods that limit the ecological validity of the behaviors. Behavioral data attempts to create more ecologically valid assessments of behavior while still in the controlled setting of a lab space, and yet it is acknowledged that laboratory assessments still prevent assessment of a full array of naturally occurring behaviors.

In conclusion, findings from the current thesis study contribute to the literature by clarifying the role of behaviorally coded AC in the relation between temperament and distinct externalizing behaviors. An important takeaway is that instead of mediating any relations, attention shifting played a moderating role in both AGG and RBB. Results are consistent with

theory that describes the buffering role of attention shifting in children who are predisposed to greater negative emotionality.

References

Achenbach, T.M., & Rescorla, L.A. (2001). Manual for the ASEBA school-age forms & profiles. Burlington: University of Vermont, Research Center for Children, Youth, & Families.

Achenbach, T. M., & Rescorla, L. A. (2004). The Achenbach System of Empirically Based Assessment (ASEBA) for ages 1.5 to 18 years. In M. E. Maruish (Ed.), *The use of psychological testing for treatment planning and outcomes assessment: Instruments for children and adolescents* (pp. 179–213). Lawrence Erlbaum Associates Publishers.

Auerbach, J.G., Berger, A., Atzaba-Poria, N., Arbelle, S., Cypin, N., Friedman, A., & Landau, R. (2008). Temperament at 7, 12, and 25 months in children at familial risk for ADHD. *Infant and Child Development, 17*(4), 321-338. https://doi.org/10.1002/icd.579

Bater L.R., & Jordan, S.S. (2017). Child routines and self-regulation serially mediate parenting practices and externalizing problems in preschool children. *Child and Youth Care Forum, 46,* 243-259. https://doi.org/10.1007/s10566-016-9377-7

Becht, A., Prinzie, P., Deković, M., van den Akker, A., & Shiner, R.L. (2016). Child personality facets and overreactive parenting as predictors of aggression and rule-breaking trajectories from childhood to adolescence. *Development and Psychopathology, 28*, 399-413. https://doi.org/ 10.1017/S0954579415000577

Behrendt, H.F., Wade, M., Bayet, L., Nelson, C.A., & Enlow, B. (2020). Pathways to social-emotional functioning in the preschool period: The role of child temperament and maternal anxiety in boys and girls. *Development and Psychopathology, 32*, 961-974. https://doi.org/10.1017/S0954579419000853

Bell, M.A., Ashley, R.A., Zhou, Y., Shin, E., Hernandez, E., Slough, M.A., Vlahcevic, K., Scarpa, A., Dunsmore, J.C., & Smith, C.L. (2019, September). Infant frontal EEG

asymmetry predicts toddler physiological and behavioral synchrony with mother during puzzle interaction task. Poster presented at Society for Psychophysiological Research, Washington DC.

Belsky, J., Fearon, R.M.P., & Bell, B. (2007) Parenting, attention, and externalizing problems: Testing mediation longitudinally, repeatedly, and reciprocally. *Journal of Child Psychology and Psychiatry, 48*(12), 1233-1242. https://doi.org/10.1111/j.1469-7610.2007.01807.x

Bérubé, R. L., & Achenbach, T. M. (2010). Bibliography of published studies using the Achenbach system of empirically based assessment (ASEBA). Burlington, VT: University of Vermont, Research Center for Children, Youth, and Families.

Burt, S. A. (2009). Rethinking environmental contributions to child and adolescent psychopathology: A meta-analysis of shared environmental influences. *Psychological Bulletin, 135(*4), 608–637. https://doi.org/10.1037/a0015702

Burt, S.A. (2012). Do etiological influences on aggression overlap with those on rule breaking? A meta-analysis. *Psychological Medicine, 43*(9), 1801-1812. https://doi.org/10.1017/S0033291712001894

Calkins, S. D. (2004). Early attachment processes and the development of emotional self-regulation. In R. F. Baumeister & K. D. Vohs (Eds.), *Handbook of self-regulation: Research, theory, and applications* (pp. 324–339). The Guilford Press.

Campbell, S.B., Spieker, S., Vandergrift, N., Belsky, J., & Burchinal, M. (2010). Predictors and sequelae of trajectories of physical aggression in school-age boys and girls. *Development and Psychopathology, 22*(1), 133–150. https://doi.org/10.1017/S0954579409990319

Coie, J. D., & Dodge, K. A. (1998). Aggression and antisocial behavior. In W. Damon & N. Eisenberg (Ed.), *Handbook of child psychology: Social, emotional, and personality development* (pp. 779–862). John Wiley & Sons, Inc.

DeHaan, A., Prinzie, P., & Deković, M. (2012). Change and reciprocity in adolescent aggressive and rule-breaking behaviors and parental support and dysfunctional discipline. *Development and Psychopathology, 24*(1), 301-315. https://doi.org/10.1017/S0954579411000848

DeMarte, J. (2008). The heterogeneity of antisocial behavior: Evidence for distinct dimensions of physical aggression, rule-breaking, and social aggression [Unpublished doctoral dissertation]. Michigan State University.

Eigsti, I., Zayas, V., Mischel, W., Shoda, Y., Ayduk, O., Dadlani, M.B., Davidson, M.C., Aber, J.L., & Casey, B.J. (2006). Predicting cognitive control from preschool to late adolescence and young adulthood. *Psychological Science, 17*(6), 478-484. https://doi.org/10.1111/j.1467-9280.2006.01732.x

Eisenberg, N., & Fabes, R. A. (1992). Emotion, regulation, and the development of social competence. In M. S. Clark (Ed.), *Emotion and social behavior* (pp. 119–150). Sage Publications.

Eisenberg, N., Fabes, R.A., Guthrie, I.K., & Reiser, M. (2000). Dispositional emotionality and regulation: Their role in predicting quality of social functioning. *Journal of Personality and Social Psychology, 78*(1), 136-157. https://doi.org/10.1037/0022-3514.78.1.136

Eisenberg, N., Guthrie, I.K., Fabes, R.A., Resier, M., Murphy, B.C., Holgren, R., Maszk, P., & Losoya, S. (1997). The relations of regulation and emotionality to resiliency and

competent social functioning in elementary school children. *Child Development, 68*(2), 295-311. https://doi.org/10.2307/1131851

Eley, T.C., Lichtenstein, P., & Moffitt, T.E. (2003). A longitudinal behavioral genetic analysis of the etiology of aggressive and nonaggressive antisocial behavior. *Development and Psychopathology, 15*, 383-402. https://doi.org/10.1017/S095457940300021X

Frick, M.A., Forslund, T., Fransson, M., Johansson, M., Bohlin, G., & Brocki, K.C. (2017). The role of sustained attention, maternal sensitivity, and infant temperament in the development of early self-regulation. *British Journal of Psychology, 109,* 277-298. https://doi.org/10.1111/bjop.12266

Gerardi-Caulton, G. (2000). Sensitivity to spatial conflict and the development of self-regulation in children 24–36 months of age. *Developmental Science, 3*(4), 397–404. https://doi.org/10.1111/1467-7687.00134

Hay, D. F. (2005). The beginnings of aggression in infancy. In R. E. Tremblay, W. W. Hartup, & J. Archer (Eds.), *Developmental origins of aggression* (pp. 107–132). Guilford Press.

Hassan, R., Poole, K.L., & Schmidt, L.A. (2020). Revisiting the double-edged sword of self-regulation: Linking shyness, attentional shifting, and social behavior in preschoolers. *Journal of Experimental Child Psychology, 196*(104865). https://doi.org/10.1016/j.jecp.2020.104842

Hayes, A. (2021). Introduction to mediation, moderation, and conditional processes analysis: A regression-based approach (3rd ed.). The Guilford Press.

Holmboe, K. (2016). Surgency. In V. Zeigler-Hill & T. K. Shackelford (Eds.), *Encyclopedia of Personality and Individual Differences* (pp. 1–6). Springer International Publishing. https://doi.org/10.1007/978-3-319-28099-8_2123-1

Hukkelberg, S., Keles, S., Odgen, T., & Hammerstrøm, K. (2019). The relation between behavioral problems and social competence: A correlational meta-analysis. *BMC Psychiatry, 19,* 354. https://doi.org/10.1186/s12888-019-2343-9

Johnson M.H, Posner M.I, & Rothbart MK. (1991). Components of visual orienting in early infancy: Contingency learning, anticipatory looking, and disengaging. *Journal of Cognitive Neuroscience, 3*(4), 335– 344. https://doi.org/10.1162/jocn.1991.3.4.335

Kahle, S., Utendale, W.T., Widaman, K.F., & Hastings, P.D. (2018). Parasympathetic regulation and inhibitory control predict development of externalizing problems in early childhood. *Journal of Abnormal Child Psychology, 46*, 237-249. https://doi.org/10.1007/s10802-017-0305-6

Klahr, A.M., & Burt, S.A. (2014). Practitioner Review: Evaluation of the known behavioral heterogeneity in conduct disorder to improve its assessment and treatment. *The Journal of Child Psychology and Psychiatry, 55*(12), 1300-1310. https://doi.org/10.1111/jcpp.12268

Kochanska, G., & Radke-Yarrow, M. (1992). Inhibition in toddlerhood and the dynamics of the child's interaction with an unfamiliar peer at age five. *Child Development, 63*, 325–335. https://doi.org/10.2307/1131482

Kostyrka-Allchorne, K., Wass, S.V., Sonuga-Burke, E.J.S. (2020). Research review: Do parent ratings of infant negative emotionality and self-regulation predict psychopathology in childhood and adolescence? A systematic review and meta-analysis of prospective longitudinal studies. *Journal of Child Psychology and Psychiatry, 61*(4), 401-416. https://doi.org/10.1111/jcpp.13144

Miller, C., Miller, S., Healey, D., Marshall, K., & Halperin, J. (2013). Are cognitive control and stimulus-driven processes differentially linked to inattention and hyperactivity in preschoolers? *Journal of Clinical Child and Adolescent Psychology, 42*(2), 187–196, http://dx.doi.org/10.1080/15374416.2012.759116.

Morales, S., Perez-Edgar, K., & Buss, K. (2016). Longitudinal relations among exuberance, externalizing behaviors, and attentional bias to reward: The mediating role of effortful control. *Developmental Science, 19*(5), 853-862. https://doi.org/10.1111/desc.12320

Morris, N., Keane, S., Calkins, S., Shanahan, L., & O'Brien, M. (2014). Differential components of reactivity and attentional control predicting externalizing behavior. *Journal of Applied Developmental Psychology, 35,* 121-127. https://doi.org/10.1016/j.appdev.2014.02.002

Morrison, A.S. & Heimberg, R.G. (2013). Attentional control mediates the effect of social anxiety on positive affect. Journal of Anxiety Disorders, 27(1), 56-67. https://doi.org/10.1016/j.janxdis.2012.10.002

Niv, S., Tuvblad, C., Raine, A., & Baker, L.A. (2013). Aggression and rule-breaking: Heritability and stability of antisocial behavior problems in childhood and adolescence. *Journal of Criminal Justice, 41*(5), 285-291. https://doi.org/10.1016/j.jcrimjus.2013.06.014

Okano, L., Jeon, L., Crandall, A., Powell, T., & Riley A. (2020). The cascading effects of externalizing behaviors and academic achievement across developmental transitions: Implications for prevention and intervention. *Prevention Science, 21*, 211-221. https://doi.org/10.1007/s11121-019-01055-9

Perez-Edgar, K., Morales, S., LoBue, V., Taber-Thomas, B.C., Allen, E.K., Brown, K.M., & Buss, K.A. (2017). The impact of negative affect on attention patterns to threat across the

first two years of life. *Developmental Psychology, 53*(12), 2219-2232. https://doi.org/10.1037/dev0000408

Posner, M.I., Inhoff, A.W., Friedrich, F.J., & Cohen, A. (1987). Isolating attentional systems: A cognitive-anatomical analysis. *Psychobiology, 15*(2), 107-121.

Posner, M. I., & Rothbart, M. K. (2000). Developing mechanisms of self-regulation. *Development and Psychopathology, 12*(3), 427–441. https://doi.org/10.1017/s0954579400003096

Posner, M. I., & Rothbart, M. K. (2013). Development of attention networks. In B. R. Kar (Ed.), *Cognition and brain development: Converging evidence from various methodologies* (pp. 61–83). American Psychological Association. https://doi.org/10.1037/14043-004

Putnam, S., Ellis, L.K., & Rothbart, M.K. (2001). The structure of temperament from infancy through adolescence. In A. Eliasz & A. Angleitner (Eds.), *Advances in research on temperament* (pp. 163-180). Pabst Science Publishers.

Putnam, S.P., Ellis, L.K., & Rothbart, M.K. (2006). Measurement of fine-grained aspects of toddler temperament: The Early Childhood Behavior Questionnaire. *Infant and Behavior Development, 29*(3), 386-401. https://doi.org/10.1016/j.infbeh.2006.01.004

Putnam, S.P., Rothbart, M.K., & Gartstein, M.A. (2008). Homotypic and heterotypic continuity of fine-grained temperament during infancy, toddlerhood, and early childhood. *Infant and Child Development, 37*, 387-405. https://doi.org/10.1002/ICD.582

Reef, J., Diamantopoulou, S., van Meurs, I., Verhulst, F.C., & van der Ende, J. (2011). Developmental trajectories of child to adolescent externalizing behavior and adult DSM-IV disorder: results of a 24-year longitudinal study. *Social Psychiatry and Psychiatric Epidemiology, 46*, 1233-1241. https://doi.org/10.1007/s00127-010-0297-9

Rhemtulla, M., & Little, T. D. (2012). Planned missing data designs for research in cognitive development. *Journal of Cognition and Development, 13*, 425–438. https://doi.org/10.1080/15248372.2012.717340

Rothbart, M.K. (2012). Advances in temperament: History, concepts, and measures. In M. Zentner & R.L. Shiner (Eds.), *Handbook of temperament* (pp. 3-20). Guilford.

Rothbart, M.K., Ahadi, S.A., & Hershey, K.L. (1994). Temperament and social behavior in childhood. *Merrill-Palmer Quarterly, 40*(1), 21-39.

Rothbart, M.K. & Bates, J.E. (2006) Temperament. In: W. Damon, & N. Eisenberg (Eds.), *Handbook of child psychology: Volume 3, Social, Emotional, and Personality Development* (6th ed., pp. 105-176). Wiley.

Rothbart, M. K., & Derryberry, D. (1981). Development of individual differences in temperament. In M. E. Lamb & A. L. Brown (Eds.), *Advances in developmental psychology* (pp. 37-86). Erlbaum.

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. https://doi.org/10.1111/j.1750-8606.2007.00002.x

Rueda, M.R., Checa, P., & Rothbart, M.K. (2010). Contributions of attentional control to socioemotional and academic development. *Early Education and Development, 21*(5), 744-764. https://doi.org/10.1080/10409289.2010.510055

Rueda, M.R., & Conjero, A. (2020). Developing attention and self-regulation in infancy and childhood. In J. Rubenstein, P. Rakic, B. Chen, & K.Y. Kwan (Eds.), *Comprehensive developmental neuroscience: Neural circuit and cognitive development* (2nd ed., pp. 505-517). Elsevier Science. https://doi.org/10.1016/B978-0-12-814411-4.00023-8

Ruff, H.A., & Rothbart, M.K. (1996). Attention in early development: Themes and variations. Oxford University Press.

Sawyer, A., Miller-Lewis, L.R., Searle, A.K., & Sawyer, M.G. (2015). Is greater improvement in early self-regulation associated with fewer behavioral problems later in childhood? *Developmental Psychology, 51*(12), 1740-1755. http://dx.doi.org/10.1037/a0039829

Spinrad, T. L., Eisenberg, N., Silva, K. M., Eggum, N. D., Reiser, M., Edwards, A., Iyer, R., Kupfer, A. S., Hofer, C., Smith, C. L., Hayashi, A., & Gaertner, B. M. (2012). Longitudinal relations among maternal behaviors, effortful control, and young children's committed compliance. *Developmental Psychology, 48*(2), 552–566. https://doi.org/10.1037/a0025898

Tackett, J. L. (2010). Toward an externalizing spectrum in DSM–V: Incorporating developmental concerns. *Child Development Perspectives, 4*(3), 161-167. https://doi.org/10.1111/j.1750-8606.2010.00138.x

Tice, D.M., Bratslavsky, E., & Baumeister, R.F. (2001). Emotional distress regulation takes precedence over impulse control: If you feel bad, do it! *Journal of Personality and Social Psychology, 80*(1), 53-67. https://doi.org/10.1037//0022-3514.80.1.53

Todd, R. M., Cunningham, W. A., Anderson, A. K., & Thompson, E. (2012). Affect-biased attention as emotion regulation. *Trends in Cognitive Sciences, 16,* 365–372.

Tremblay, R.E. (2010). Developmental origins of disruptive behavior problems: The “original sin” hypothesis, epigenetics and their consequences for prevention. *Journal of Child Psychology and Psychiatry, and Allied Disciplines, 51*, 341–367.

Ursache, A., Blair, C., Stifter, C., & Voegtline, K. (2010). Emotional reactivity and regulation in infancy interact to predict executive functioning in early childhood. *Developmental Psychology, 49*(1), 127-137. https://doi.org/10.1037/a0027728

Valiente, C., Eisenberg, N., Spinrad, T. L., Reiser, M., Cumberland, A., Losoya, S. H., & Liew, J. (2006). Relations among mothers' expressivity, children's effortful control, and their problem behaviors: A four-year longitudinal study. *Emotion, 6*(3), 459–472. https://doi.org/10.1037/1528-3542.6.3.459

Van Ginkel, J.R., Linting, M., Rippe, R.C.A., van der Voort, A. (2020). Rebutting existing misconceptions about multiple imputation as a method for handling missing data. *Journal of Personality Assessment, 102*(3), 297-308. https://doi.org/10.1080/00223891.2018.1530680

Verona, E., Patrick, C. J., & Lang, A. R. (2002). A direct assessment of the role of state and trait negative emotion in aggressive behavior. *Journal of Abnormal Psychology, 111*(2), 249–258. https://doi.org/10.1037/0021-843X.111.2.249

Whedon, M., Perry, N.B., Calkins, S.D., & Bell, M.A. (2016). Changes in frontal EEG coherence across infancy predict cognitive abilities at age 3: The mediating role of attentional control. *Developmental Psychology, 52*(9), 1341-1352. http://dx.doi.org/10.1037/dev0000149

White, I.R., Royston, P., Wood, A.M. (2011). Multiple imputation using chained equations: Issues and guidance for practice. *Statistics in Medicine, 30*(4), 377-399. https://doi.org/10.1002/sim.4067

Wilson, B. J. (2003). The role of attentional processes in children's prosocial behavior with peers: Attention shifting and emotion. *Development and Psychopathology, 15*(2), 313–329. https://doi.org/10.1017/S0954579403000178

Yang, H., Chen, W., Soong, W. (2001). Rates and patterns of comorbidity of adolescent behavioral syndromes as reported by parents and teachers in a Taiwanese nonreferred sample. *Journal of the American Academy of Child & Adolescent Psychiatry, 40*(9), 1045-1052. https://doi.org/10.1097/00004583-200109000-00013

Table 1

CBCL Rule-Breaking Scale Questions	M
Drinks alcohol without parents' approval	.000*
Doesn't seem to feel guilty after misbehaving	.237
Breaks rules at home, school, or elsewhere	.497
Hangs around with others who get in trouble	.090
Lying or cheating	.299
Prefers being with older kids	.701
Runs away from home	.000*
Sets fires	.011
Sexual problems	.000*
Steals at home	.057
Steals outside the home	.017
Swearing or obscene language	.034
Thinks about sex too much	.000*
Smokes, chews, or sniffs tobacco	.000*
Truancy, skips school	.000*
Uses drugs for nonmedical purposes	.000*
Vandalism	.000*

Note: * = zero variance

Table 2

CBCL Aggressive Behavior Scale Questions	M
Argues a lot	.740
Cruelty, bullying, or meanness to others	.141
Demands a lot of attention	.559
Destroys his/her own things	.226
Destroys things belonging to his/her family or others	.226
Disobedient at home	.554
Disobedient at school	.249
Gets in many fights	.085
Physically attacks people	.131
Screams a lot	.209
Stubborn, sullen, or irritable	.441
Sudden changes in mood or feelings	.305
Sulks a lot	.192
Suspicious	.068
Teases a lot	.130
Temper tantrums or hot temper	.452
Threatens people	.085
Unusually loud	.294

Table 3

Descriptive Information for Study Variables Using Listwise Deletion

Variables	N	M	SD	Skewness	Kurtosis
NA (2yr)	215	3.12	.54	.29	.25
FA (4yr)	179	.83	.26	-1.62	1.69
SHF (4yr)	179	1.79	1.97	.94	-.27
RBB (6yr)	230	54.37	4.98	1.36	1.12
AGG (6yr)	230	54.42	6.13	1.69	2.41
EXT (4yr)	195	48.05	10.11	.40	.63

Note: Descriptive information based on winsorized data. NA = negative affectivity; FA = focused attention; SHF = shifting behaviors; RBB = rule-breaking behaviors; AGG = aggressive behaviors; EXT = externalizing behaviors.

Table 4

Descriptive Information for Study Variables After Imputation

	N	M	SD	Skewness	Kurtosis
NA (2yr)	230	3.12	.52	.29	.37
FA (4yr)	230	.80	.24	-1.21	1.08
SHF (4yr)	230	1.48	1.84	1.30	.59
RBB (6yr)	230	54.38	4.98	1.36	1.12
AGG (6yr)	230	54.42	6.13	1.69	2.41
EXT (4y)	230	47.96	9.60	.45	.86

Note: Descriptive information based on winsorized data. NA = negative affectivity; FA = focused attention; SHF = shifting behaviors; RBB = rule-breaking behaviors; AGG = aggressive behaviors; EXT = externalizing behaviors.

Table 5

Correlations for Study Variables After Imputation

	NA (2y)	FA (4y)	SHF (4yr)	RBB (6yr)	AGG (6yr)	EXT (4yr)
NA (2yr)	--					
FA (4yr)	-.14*	--				
SHF (4yr)	.01	-.30**	--			
RBB (6yr)	.14*	.02	-.02	--		
AGG (6yr)	.21**	-.04	-.04	.70**	--	
EXT (4yr)	.36**	-.06	.04	.47**	.56**	--

Note: *$p < .05$, **$p < .01$. Correlations based on winsorized data. NA = negative affectivity; FA = focused attention; SHF = shifting behaviors; RBB = rule-breaking behaviors; AGG = aggressive behaviors; EXT = externalizing behaviors.

Table 6

SHF Behavior Moderates Association Between Toddler NA and Childhood AGG

	B	SE	t	p	LLCI	ULCI
EXT (4yr)	.36	.04	9.66	<.001	.29	.43
NA (2yr)	-.17	.69	-.25	.80	-1.53	1.19
SHF (4yr)	-.17	.18	-.94	.35	-.53	.19
NA*SHF	-.96	.40	-2.42	.02	-1.74	-.18

Note: $R^2 = .34$, $F(4, 225) = 28.55$, $p < .001$. EXT = externalizing behaviors. NA = negative affectivity; SHF = shifting behaviors; AGG = aggressive behaviors.

Table 7

SHF Behavior Moderates Association Between Toddler NA and Childhood RBB

	B	SE	t	p	LLCI	ULCI
EXT (4yr)	.25	.03	7.92	<.001	.19	.32
NA (2yr)	-.63	.59	-1.06	.29	-1.80	.54
SHF (4yr)	-.08	.16	-.53	.60	-.39	.23
NA*SHF	-1.02	.34	-2.98	.003	-1.69	-.34

Note: $R^2 = .25$, $F(4, 225) = 19.28$, $p < .001$. EXT = externalizing behaviors; NA = negative affectivity; SHF = shifting behaviors; RBB = rule-breaking behaviors.

Table 8

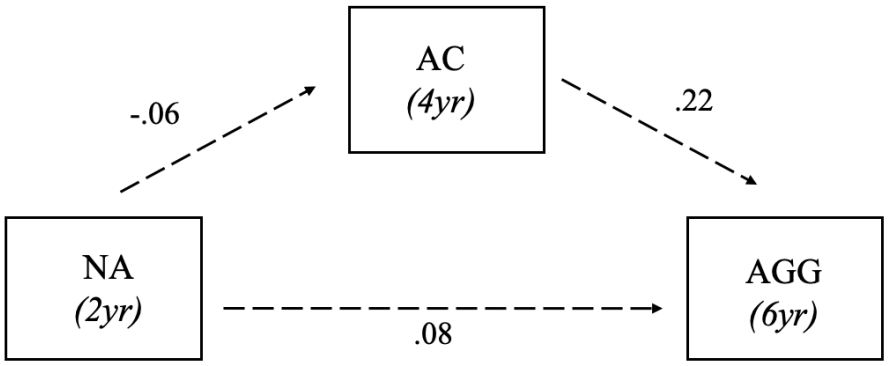
AC Moderates Association Between Toddler NA and Childhood RBB

	B	SE	t	p	LLCI	ULCI
EXT (4yr)	.25	.03	7.70	<.001	.18	.31
NA (2yr)	-.19	.31	-.61	.54	-.80	.42
AC (4yr)	.34	.36	.95	.34	-.37	1.06
NA*AC	.98	.36	2.70	.01	.27	1.70

Note: $R^2 = .25$, $F(4, 225) = 18.84$, $p < .001$. EXT = externalizing behaviors; NA = negative affectivity; AC = attentional control; RBB = rule-breaking behaviors.

Figure 1

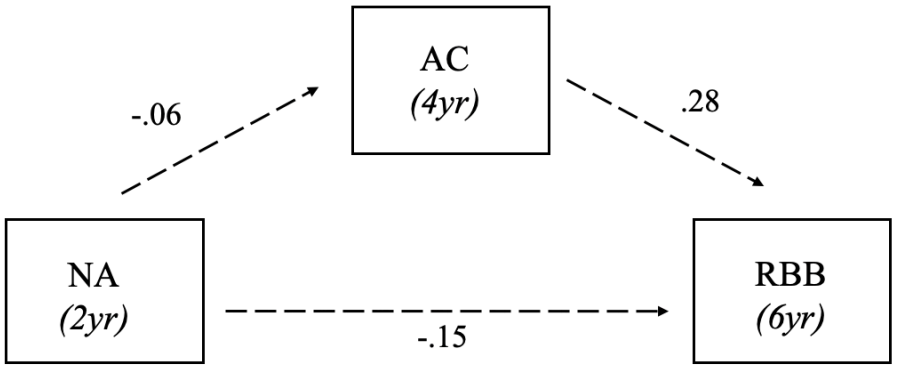
Hypothesized mediation model with AGG



Note. Standardized estimates presented. Dotted lines represent non-significant paths. NA = negative affectivity; AC = attentional control; AGG = aggressive behaviors.

Figure 2

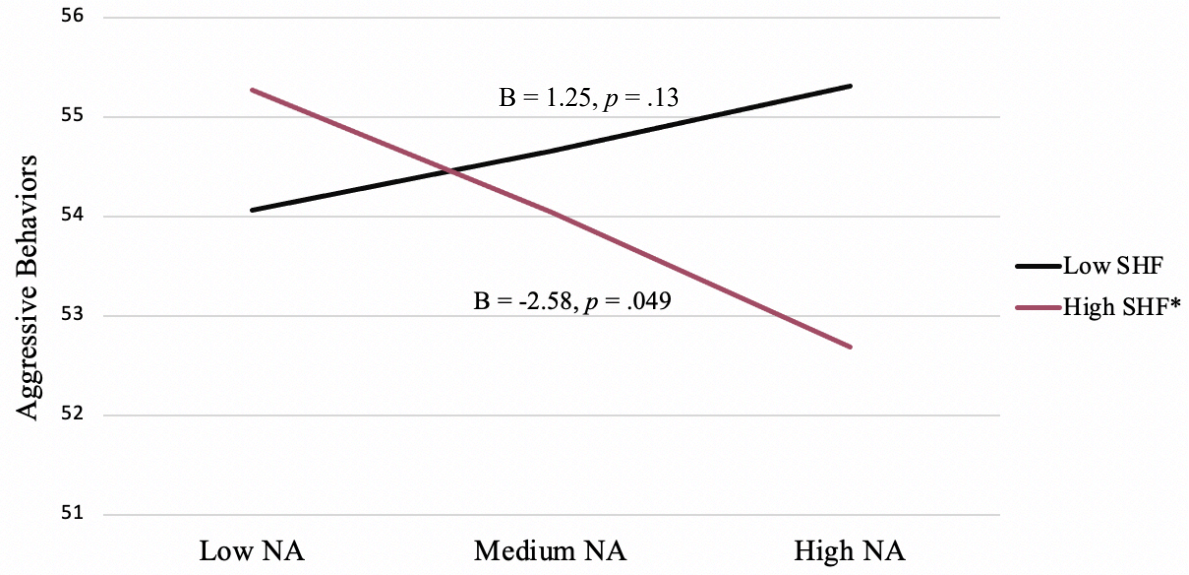
Hypothesized mediation model with RBB



Note. Standardized estimates presented. Dotted lines represent non-significant paths. NA = negative affectivity; AC = attentional control; RBB = rule-breaking behaviors.

Figure 3

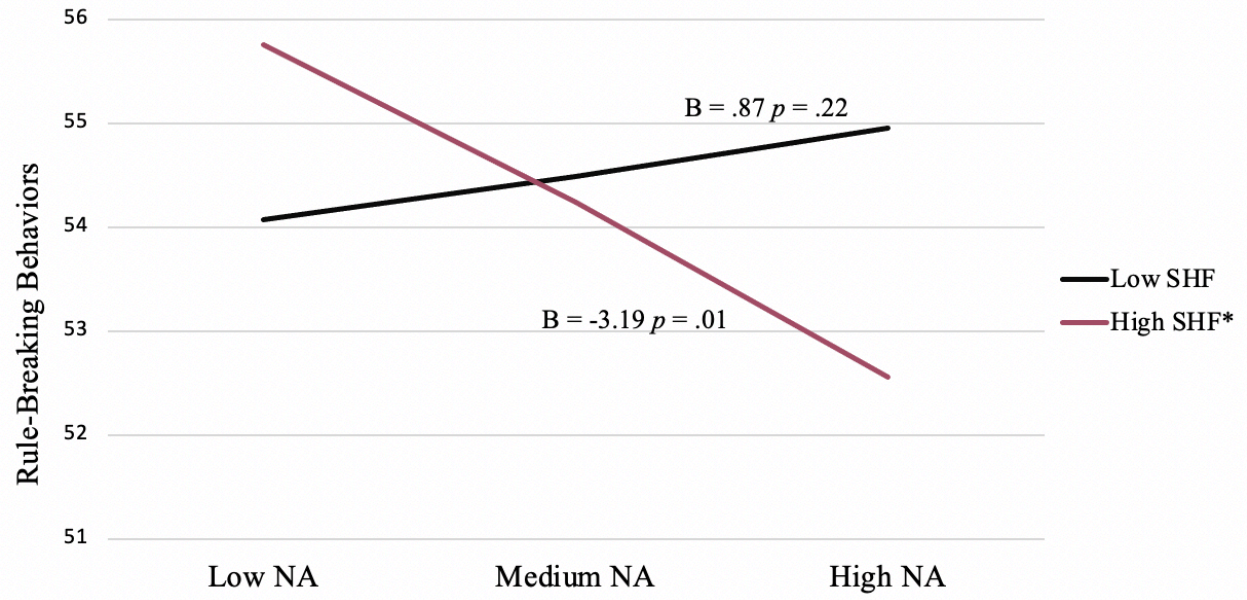
High SHF Behaviors Moderates Relation Between NA and AGG



Note. * = p < .05; NA = negative affectivity; SHF = shifting behaviors.

Figure 4

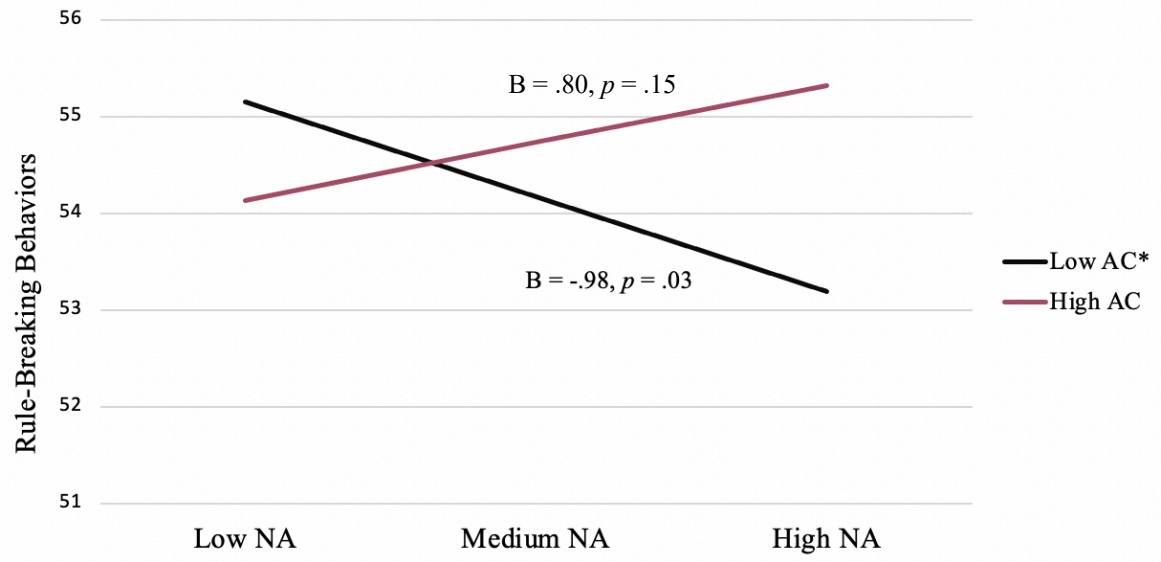
High SHF Behaviors Moderates Relation Between NA and RBB



Note. * = p < .05; NA = negative affectivity; SHF = shifting behaviors.

Figure 5

Low AC Moderates Relation Between NA and RBB



Note. * = p < .05; NA = negative affectivity; AC = attentional control.

Appendix A

Attention Coding Scheme

- The puzzle task starts when the Experimenter gets up from the table after instructions
- Puzzle task ends when Experimenter interjects to end the task (e.g., "Nice job!" "How'd it go?").

Attention Behaviors– 2 continuous codes. Behaviors should begin as soon as behavior starts and ends as soon as the behavior stops.

1. **Focused Attention (FA):** This is coded for when the child is actively focusing attention on the task at hand and is actively working on the task. A child may express that they do not know how/do not want to do the task, but if they are holding a puzzle piece and scanning the board while they say it, still code as FA. If a child takes their eyes off the board to look around for less than four seconds, and goes back to looking at the board, code as FA.

   Examples of FA during Puzzles:
   - Child is placing puzzle pieces by themselves
   - Child is holding a puzzle piece and/or scanning the board
   - Talking to their parent, but still looking at the board (e.g., just talking to themselves)

2. **Off-task (O):** Child has trouble focusing on the task and is not working to complete the task. This behavior encompasses all behaviors that are not coded as FA. If the child is not focusing attention on the puzzle while expressing they do not know how to do the puzzle or are asking for help, this is off-task because they are not attempting to complete the puzzle by themselves.

   Examples of Puzzles Off-task:
   - Starts playing with puzzle pieces in a way that is not intended
   - Stops looking at board to ask parent/experimenter for help or starts a conversation about anything, even if they have their hand on a puzzle piece
   - Child expresses not wanting to do the task or does not know how to do the task while NOT working on the task (e.g., not looking at the board or at a puzzle piece)
   - Child is not working on the task (e.g. day dreaming, talking to themselves, sitting in silence)