EFFORTFUL CONTROL, INTERPRETATION BIASES, AND CHILD ANXIETY SYMPTOM SEVERITY IN A SAMPLE OF CHILDREN WITH ANXIETY DISORDERS

A Thesis

Presented to

The Faculty of the Department

of Psychology

University of Houston

In Partial Fulfillment

Of the Requirements for the Degree of

Master of Arts

By

Elizabeth M. Raines

May, 2019

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ABSTRACT

Introduction: The present investigation examined associations between effortful control (and its subcomponents: attention control and inhibitory control) and anxiety symptom severity, by way of interpretation biases, in a diverse sample of clinically anxious youth. It was hypothesized that effortful control would be inversely related to interpretation biases and child anxiety symptoms. It was also hypothesized that interpretation biases would significantly mediate the association between effortful control and child anxiety symptom severity. Each subcomponent of effortful control (i.e., attention control and inhibitory control), as well as the total construct, was examined in tests of mediation. **Method:** Participants (N = 105; M_{age} = 10.09 years, SD = 1.22; 56.7% female; 49% ethnic minority) completed a diagnostic interview; self-report measures of temperament, anxiety, and interpretation biases; a performance-based assessment of interpretation biases; and a parent-child interaction task. **Results:** Multiple mediator models indicated a significant indirect effect of effortful control (completely standardized point estimate = -.24, SE = .06, BC 95% CI [-.36, -.14]), attentional control (completely standardized point estimate = -.22, SE = .06, BC 95% CI [-.34, -.12]), and inhibitory control (completely standardized point estimate = -.19, SE = .05, BC 95% CI [-.31, -.09]) on *self-reported* anxiety symptom severity through self-reported, but not behaviorally-indexed, interpretation biases. Multiple mediator models predicting *behaviorally-indexed* child anxiety severity were not significant. **Discussion:** Clinically anxious children with higher levels of effortful control (and its subcomponents) are less likely engage in biased interpretations, which may lower their anxiety. Future work should evaluate whether targeting these malleable temperamental constructs leads to clinically meaningful reductions in interpretation biases and child anxiety symptoms.

TABLE OF CONTENTS

LIST OF FIGURES AND TABLES

Introduction

Anxiety disorders are one of the most common mental illnesses among children, with an estimated 12-month prevalence rate of 12.3% (Costello, Egger, Copeland, Erkanli, & Angold, 2011) and a lifetime prevalence exceeding 30% (Merikangas et al., 2010). Childhood anxiety disorders are also chronic and associated with substantial impairment across peer (Scharfstein, Alfano, Beidel, & Wong, 2011), family (Towe-Goodman, Franz, Copeland, Angold, & Egger, 2014), and academic domains (Ialongo, Edelsohn, Werthamer-Larsson, Crockett, & Kellam, 1995). For example, youth with anxiety disorders are significantly more likely to experience major depression, illicit drug dependence, and failure to attend to college in young adulthood even after accounting for the effects of relevant covariates (e.g., parental drug use, deviant peer involvement; Woodward & Fergusson, 2001). Long-term follow up data from treatment outcome studies is also discouraging; over a four-year period after receiving state-of-the-art treatment for anxiety disorders, only 22% of youth were found to be in stable remission, whereas 30% remained chronically ill and 48% had relapsed (Ginsburg et al., 2018). These findings underscore a clear need for increased understanding of risk and protective mechanisms involved in childhood anxiety disorders (Kendall et al., 2016).

Effortful control—the ability to utilize executive functions to inhibit an impulsive reaction in favor of a response that better aligns with one's long-term goals (Lonigan & Vasey, 2009; Rothbart & Bates, 2006)—has been identified as a protective factor against childhood anxiety. For example, a child with high effortful control may choose to interact with his new classmates, instead of avoid them, in order to achieve his socialization goals. In contrast, a child with low effortful control may hastily avoid this situation at the slightest sign of discomfort. Conceptualized as a temperamental trait, effortful control is thought to be largely innate

(Kochanska & Knaack, 2003), with heritability estimates ranging from 68-79% (Lemery-Chalfant, Doelger, & Goldsmith, 2008), and to develop progressively as a result of brain maturation and environmental influences (Posner & Rothbart, 2003; Rothbart & Bates, 1998). Young children show marked increases in effortful control and maintain fairly stable rank ordering as they mature, such that children who score high on effortful control measures continue to do so over time (Davis, Bruce, & Gunnar, 2002; Kochanska, Murray, & Harlan, 2000). Neuroimaging data as well as neuropsychological tasks targeting the anterior attentional system (Davis et al., 2002; Posner, 1995) corroborate the rapid development of these skills in childhood (Carlson & Moses, 2001; Morasch & Bell, 2011).

Theory suggests that effortful control is comprised of two interrelated skills (Muris & Ollendick, 2005): *attentional control*, which reflects the capacity to focus attention as well as to shift attention when desired (Muris, van der Pennen, Sigmond, & Mayer, 2008), and *inhibitory control*, which refers to the ability to monitor and control conscious thought as well as to inhibit or delay a prepotent response (Carlson & Moses, 2001). To illustrate, consider a family traveling at the airport that just lost their boarding passes. The child with high attentional control may choose to focus attention on staying calm instead of focusing on her mother's anxiety for having misplaced the boarding passes. Likewise, the child with high inhibitory control may resist engaging in catastrophic thinking ("We are going to miss our flight! Our vacation is ruined!") in favor of finding someone who can help with getting new boarding passes. Research has found that high effortful control and/or its subcomponents are protective against psychopathology (White, McDermott, Degnan, Henderson, & Fox, 2011), whereas deficits in this self-regulatory construct are related to mental health problems (Eisenberg, Hofer, & Vaughan, 2007; Niditch & Varela, 2018), including anxiety disorders (Muris & Ollendick, 2005).

Several studies have linked low effortful control with increased child anxiety symptoms (e.g., Lonigan & Vasey, 2009; Muris & Ollendick, 2005; Niditch & Varela, 2018). For example, in a study of 216 children ages 3-7, Scheper and colleagues (2017) found that clinically referred children exhibited less effortful control than healthy controls, and that effortful control was negatively associated with internalizing problems. A separate investigation also found that effortful control was negatively associated with child anxiety symptoms, and that effortful control in the preschool years mediated the relation between infant behavioral inhibition and anxiety symptoms in early childhood (Niditch & Varela, 2018). Although these studies support a relation between low effortful control and child anxiety symptom severity, the cognitive mechanisms underlying these associations are poorly understood. This is unfortunate, given burgeoning evidence suggesting that cognition may be a crucial domain linking temperamental risk for anxiety with the development of anxiety disorders (Pérez-Edgar et al., 2010; Viana & Gratz, 2012). Indeed, a recent study of a community-based sample of children found that attentional control and worry serially mediated the relation between fearful temperament and childhood anxiety (Gramszlo, Geronimi, Arellano, & Woodruff-Borden, 2018).

One cognitive factor that may undergird the association between effortful control and child anxiety symptoms is interpretation biases—the tendency to interpret neutral or ambiguous situations as negative or threatening (Weems & Silverman, 2008). Consistent with cognitive theories of emotional disorders, interpretation biases confer significant risk for the development and maintenance of anxiety, and their role in childhood anxiety has been established in studies using various methodologies (Creswell, Schniering, & Rapee, 2005). Specifically, studies have shown that children with (vs. without) anxiety disorders are more likely to interpret ambiguous situations in a threatening manner (Taghavi, Neshat-Doost, Moradi, Yule, & Dalgleish, 1999) irrespective of negative affect (Miers, Blöte, Bögels, & Westenberg, 2008), and experimental investigations have reported that anxious children provide more threatening interpretations to ambiguous vignettes than controls (Barrett, Rapee, Dadds, & Ryan, 1996; Chorpita, Albano, & Barlow, 1996). Longitudinal research also has found associations between interpretation biases and anxiety symptom maintenance over time (Creswell & O'Connor, 2011; Dodd, Hudson, Morris, & Wise, 2012), and clinical trials report reductions in threat interpretations, lower social anxiety, and lower anxiety about an anticipated social encounter among children who are trained to interpret situations more positively (Vassilopoulos, Banerjee, & Prantzalou, 2009).

One well established measure of interpretation biases in children is the Children's Negative Cognitive Error Questionnaire (CNCEQ; Leitenberg, Yost, & Carroll-Wilson, 1986), which assesses four types of interpretation errors: (a) overgeneralized predictions of negative outcomes, (b) catastrophizing about the consequences of negative events, (c) incorrectly taking personal responsibility for negative outcomes, and (d) selectively attending to negative features of an event. Investigations support the association between interpretation biases assessed via the CNCEQ and anxiety symptom severity in children (e.g., Cannon & Weems, 2010). For example, in a sample of 251 youth with anxiety disorders, catastrophizing, overgeneralization, and personalizing were correlated with trait anxiety, anxiety sensitivity, and manifest anxiety while controlling for children's level of depression (Weems, Berman, Silverman, & Saavedra, 2001) . A separate study found that self-reported and behaviorally-indexed (i.e., via a computerized task) interpretation biases were significantly associated with child-reported anxiety symptoms among youth with anxiety disorders (Viana, Dixon, Stevens, & Ebesutani, 2016). Although past work is promising, it is limited by its lack of assessment of effortful control or a multi-method perspective on childhood anxiety severity. Moreover, although cognitive mechanisms have been implicated in the link between temperament and subsequent difficulties with anxiety (Pérez-Edgar et al., 2010; Wolfe & Bell, 2007), no studies to date have specifically examined whether interpretation biases undergird the association between effortful control and childhood anxiety symptoms.

This is surprising, given that effortful control and/or its subcomponents (i.e., inhibitory control and attentional control) are reliably associated with *both* cognitive biases and anxiety symptom severity (Berggren, Richards, Taylor, & Derakshan, 2013; Cohen-Gilbert & Thomas, 2013; Gorlin & Teachman, 2015; Susa-Erdogan, Bengà, Mone, & Miclea, 2016; White et al., 2011). For example, youth low in effortful control and high in negative emotionality demonstrated a significant bias in favor of threatening cues in the context of a dot-probe paradigm. However, youth who were high in negative emotionality, yet also high in effortful control, did not exhibit this bias (Lonigan & Vasey, 2009). Likewise, Susa-Erdogan, Bengà, Mone, and Miclea (2016) found that when presented with emotional distractors (angry and happy faces), anxious children with low *inhibitory control* were less efficient during a letter discrimination task compared to anxious children with high inhibitory control. Higher interpretation biases also predicted higher levels of anxious behavior among socially anxious undergraduates with low, but not high, inhibitory control (Gorlin & Teachman, 2015).

The *attentional control* component of effortful control may also prevent children from making threatening interpretations, which in turn, may lower their anxiety (Lonigan & Vasey, 2009). For example, a child with high attentional control who witnesses a violent motor vehicle accident may more easily redirect their attention towards positive aspects about the situation (e.g., first responders assisting the injured) and prevent anxiety from escalating. Indeed, shifting attention away from threat in the environment was found to be related to lower anxiety, even among youth (N = 152) already at-risk for anxiety due to their temperamental profiles (White et al., 2011).

The Present Study

The studies reviewed above underscore the potentially protective role of effortful control (and subcomponents) and its association to interpretation biases and childhood anxiety. Yet, despite theoretical support for a model linking temperamental self-regulation (i.e., effortful control) to childhood anxiety through interpretation biases (Bar-Haim et al., 2009; Fox, Henderson, Marshall, Nichols, & Ghera, 2005), no study to date has examined such model empirically. Notably, results may help to identify the specific role of malleable temperamental (effortful control) and cognitive processes (interpretation biases) that could be explicitly targeted in prevention and intervention protocols for childhood anxiety. For example, clinically anxious children trained to shift attention away from threat have shown promising reductions in the number and severity of their anxiety symptoms compared to controls (Eldar et al., 2012).

The present study examined whether multi-method assessments of interpretation biases undergird the association between effortful control and child anxiety symptoms in a sample of children with anxiety disorders (see Figure 1). It was hypothesized that effortful control would be inversely related to interpretation biases and child anxiety symptoms (Muris & Ollendick, 2005). It was also hypothesized that interpretation biases would significantly mediate the association between effortful control and child anxiety symptoms. Each subcomponent of effortful control (i.e., inhibitory control and attention control), as well as the total construct was examined in tests of mediation. However, given the paucity of data, no specific hypotheses were made with respect to the relevance of one subcomponent over the other in mediational analyses.

Method

Participants

The present study involved secondary analysis of data from a federally-funded clinical trial (NCT02095340) investigating the role of maternal interpretation biases on child anxiety and related responses. Families were included if (a) the child was between the ages of 8-12, (b) the child had a primary anxiety disorder (by either mother or child report), (c) the mother reported levels of anxiety within the clinical range during clinical interview or on the Depression, Anxiety, and Stress Scales (DASS; Lovibond & Lovibond, 1995), and (d) the child currently lived with the mother. Children were excluded based on the following reasons: (a) physical disability impairing ability to use a computer, (b) borderline or extremely low intellectual functioning, (c) below average reading comprehension, (d) concurrent primary diagnosis of any non-anxiety disorder, (e) currently receiving psychological or pharmacological treatment for anxiety, (f) danger to self/others, and (g) non-English speaking child/parent. Because the original trial involved evaluating the effect of a computerized intervention targeting maternal cognitions, mothers were excluded if they were currently involved in cognitive behavioral therapy for anxiety (which explicitly targets cognitions) and/or if they had changes in their pharmacological treatment (for anxiety) in the past 12 weeks prior to enrollment.

The final sample was comprised of 105 children with anxiety disorders between 8 to 12 years of age (N = 105; M = 10.07 years, SD = 1.22; 57% female) and their clinically anxious mothers (M = 39.35 years, SD = 7.05; range = 26 – 61 years; 67% married). In terms of race and ethnicity, mothers identified as follows: 51.4% White, 29.5% Hispanic, 14.3% African American, 2.9% mixed ethnicity, and 1.9% Asian American. Children identified as follows: 39% White, 28.6% Hispanic, 16.2% mixed ethnicity, 14.3% African American, and 1.9% Asian

American. Twenty-three percent of families reported an annual household of < $40,000, 16% between $40,000-$69,999, 22% between $70,000-$99,999, 36% reported an annual household income > $100,000, and 2.9% did not report their income. Three percent of mothers had less than a high school education, 6.7% had a high school diploma or GED, 17.3% had some college education, 5.4% had a 2-year college degree, 34.6% had a 4-year college degree, 3.8% had completed some graduate level courses, 13.5% had a master degree, and 5.8% had a doctoral or professional degree. Fifty percent of mothers worked full time.

Children met *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.; American Psychiatric Association, 2013) criteria for at least one anxiety disorder diagnosis based on results from semi-structured interviews conducted (separately) with both the child and the mother. Generalized Anxiety Disorder was the most common anxiety disorder (46.7%), followed by Social Anxiety Disorder (27.6%), Specific Phobias (16.2%), Separation Anxiety Disorder (7.6%), and Other Anxiety Disorders (1.9%). Most of the sample (69.5%) had comorbid diagnoses, the most common being specific phobias (14.3%), attention deficit/hyperactivity disorder (12.4%), generalized anxiety disorder (8.6%), oppositional defiant disorder (7.6%), current major depressive disorder (7.6%), separation anxiety disorder (5.7%), and social anxiety disorder (5.7%).

Procedure

All procedures were approved by the Institutional Review Board. Families were recruited to participate in a larger study on mother and child anxiety through local advertisements, child-oriented events, and flyers. To ensure that an adequate number of participants had high anxiety, recruitment materials specifically encouraged families experiencing difficulties with child anxiety to participate. Interested mothers initially contacted or were contacted by study personnel via telephone or email. A description of the study was provided and a brief screen was conducted to assess for child exclusionary criteria. An initial three-hour session was scheduled with eligible families.

Upon arrival for the first session, informed consent from mothers and informed assent from children were obtained. After eligibility was confirmed, clinical interviews were conducted with mothers and children (separately) by graduate students under the direct supervision of a doctoral-level clinician. After the clinical interview, mothers and children completed (separately) a battery of questionnaires. At the end of the first session, a second one-hour session was scheduled for the following week.

During the second session, a lead experimenter assisted the child in completing a computerized interpretation bias task (WASP; see Measures) while the mother waited in an adjacent room. After completing the computerized task, the mother was brought back into the room with the child to complete a parent-child interaction task. The lead experimenter instructed the mother and the child to take 5 minutes to prepare for a speech that the child would give about his/her family once the parent-child interaction was completed. The experimenter gave the family an opportunity to ask questions and subsequently left the room for 5 minutes. After completing the interaction, the mother was asked to leave the room and the child was prompted to give a speech about his/her family in front of a recording video camera. The child was given up to 5 minutes to complete the speech. Prior to beginning the speech, the child was told that it would be rated later for quality.

Upon completion of the second session, the mother and child were fully debriefed. Information regarding the results of the diagnostic evaluation, recommended evidence-based treatments, and contact information of local mental health providers were made available to families. Families received $50 per session for their participation, and children were also able to choose a small toy after each session.

Measures

Diagnostic Interview.

MINI International Neuropsychiatric Interview for Children and Adolescents (MINI-Kid; Sheehan, 1998). The MINI Kid is a structured diagnostic interview for children from 6 to 17 years old based on DSM-5 psychiatric disorders. Twenty-four DSM-5 diagnoses are assessed with discrete modules. Each module consists of a screening item(s); if the screening item(s) is endorsed, the assessor proceeds through additional questions to determine diagnostic criteria. Separate child and parent (about the child) interviews were conducted. Interviews were completed by either a doctoral level clinician or pre-doctoral level graduate students; all psychiatric assessments were reviewed by the PI during team meetings to confirm diagnoses.

MINI International Neuropsychiatric Interview (Sheehan et al., 1998). Diagnostic assessments of mothers were performed using the MINI, which provides reliable DSM-5 diagnoses. The MINI has demonstrated good inter-rater and test-retest reliability as well as validity (Sheehan et al., 1998). The administration personnel was the same as that described above. All psychiatric assessments were reviewed by the PI during team meetings to confirm diagnoses.

Effortful Control.

Early Adolescent Temperament Questionnaire, Short Form (Ellis & Rothbart, 2001). The EATQ-RS is a 65-item, child-completed questionnaire designed to assess temperament traits in late childhood through late adolescence, and contains 11 temperament subscales (activation control, activity level, affiliation, attention, fear, frustration, high intensity pleasure, inhibitory control, perceptual sensitivity, pleasure sensitivity, and shyness) and two behavioral scales (aggression and depressive mood). Items are rated on a 5-point Likert scale, ranging from 1 (*almost never true*) to 5 (*almost always true*). Subscale scores are obtained by averaging responses to items of each subscale (i.e., subscale scores range from 1 – 5). The inhibitory control subscale, reflecting the capacity to plan and to suppress inappropriate responses (e.g., "when someone tells me to stop doing something, it is easy for me to stop;" α = .43), and the attentional control subscale reflecting the capacity to focus attention as well as to shift attention when desired (e.g., "I pay close attention when someone tells me how to do something;" α = .44) were used in the current study. Consistent with previous work (Morris & Age, 2009), an effortful control total score was also computed by averaging the attentional control and the inhibitory control subscales (α = .60).

Interpretation Biases.

Children's Negative Cognitive Error Questionnaire (CNCEQ; Leitenberg et al., 1986). The CNCEQ is a widely used 24-item self-report measure that assesses the degree to which children interpret events in an overly negative manner. The CNCEQ yields a total cognitive distortion score and the following four subscales: catastrophizing, overgeneralization, personalizing, and selective abstraction (Leitenberg et al. 1986). Each item consists of a hypothetical vignette followed by a negative interpretation of the vignette. The child is asked to rate on a 5-point Likert scale the degree to which he or she would interpret the situation in the same way (1 = *not at all like I would think* to 5 = *almost exactly like I would think*). Research has documented good test–retest reliability and internal consistency for the CNCEQ scores (Leitenberg et al. 1986). In this study, the CNCEQ total score (α = .93) was used as a self-report measure of interpretation biases.

Word-Sentence Association Paradigm (WSAP; Beard & Amir, 2009). Children completed a modified version of the Word-Sentence Association Paradigm (WSAP; Beard et al. 2011) as behaviorally-indexed assessment of interpretation biases. The task was programmed using DirectRT version 2012 (Jarvis, 2012) and displayed on a 17-in. wide-screen laptop computer screen. To enhance external validity, computerized scenarios were representative of day-to-day situations faced by children (Barrett et al., 1996). There were a total of 20 trials in the modified task. For each trial, a fixation cross appeared in the center of the computer screen for 500 ms. Next, an ambiguous sentence (e.g., your friend yawns during a conversation with you) appeared along with two words that represent either a threatening (e.g., boring) or benign (e.g., tired) interpretation of the sentence. Children were instructed to choose which of the two words best fit with the sentence by pressing the corresponding key on the keypad as quickly and accurately as possible. The stimuli remained on the computer screen until the child responded, upon which the next trial began immediately. Children performed the computerized task individually in a quiet and well-lit room. They sat on a height-adjustable chair, with their heads approximately 60 cm from the center of the screen. The proportion of threatening (vs. benign) interpretations made by participants was used as a performance-based index of interpretation biases.

Anxiety Symptoms.

Revised Child Anxiety and Depression Scale (RCADS; Chorpita, Yim, Moffitt, Umemoto, & Francis, 2000). The RCADS is a self-report measure based on the Spence Children's Anxiety Scale (Spence, 1998) and designed to assess *DSM-IV-TR* (American Psychiatric Association, 2000) separation anxiety disorder, social anxiety disorder, panic disorder, obsessive compulsive disorder, generalized anxiety disorder, and major depressive disorder symptoms in children. The child is asked to respond to 47 questions on a Likert scale (0 = *never* to 3 = *always*) regarding the extent to which he/she agrees with statements indicative of anxiety (e.g., "I worry that bad things will happen to me") and depression (e.g., "nothing is much fun anymore"). Studies show that the RCADS has good internal consistency in both clinical and community samples of youth (Chorpita et al., 2000), adequate convergent validity with established measures of anxiety and depression, and with the diagnostic syndromes it was purported to assess (Chorpita, Moffitt, & Gray, 2005). The RCADS total anxiety score ($\alpha = .95$) was used in the current study as an index of anxiety disorder symptom severity.

***Behaviorally-indexed child anxiety*.** Behavioral display of child anxiety was coded during the parent-child interaction task described above using a validated coding system (Ginsburg & Grover, 2007; Ginsburg, Grover, Cord, & Ialongo, 2006; Ginsburg, Grover, & Ialongo, 2005). Anxious behavior (e.g., expresses fear, worry, and perfectionism) was coded for each of the five minutes that comprised the parent-child interaction. An overall rating of anxious behavior for the entire task was also assigned. Child behaviors were rated on a 5-point Likert scale from 0 (no presence of the behavior) to 4 (presence of the behavior most of the time). All coders were trained by coding five "gold standard" tapes coded by the PI; coders were required to obtain at least 80% agreement before coding study tapes. All tapes were coded by two independent raters (Fleiss's kappa =.92).

Data Analytic Plan

First, variables' distributions were examined both numerically and graphically to evaluate patterns of skewness and kurtosis. The data was also examined for the presence of potential univariate and/or multivariate outliers. Patterns of missing data were examined to determine whether values are missing randomly or non-randomly. Second, correlational analyses were used to examine associations among study variables and to identify possible sociodemographic covariates, such as race/ethnicity, gender, income, and depressive symptoms. Third, a multiple mediator model was tested using the PROCESS macro for SPSS (Hayes, 2012) to examine the mediating effect of interpretation biases in the relation between effortful control (and its two subcomponents) and child anxiety symptom severity.

A total of six separate models were tested, with each model including one of three possible predictors (effortful control [EATQ-EC], attentional control [EATQ-ATT], and inhibitory control [EATQ-IC]) and one of two possible outcomes (self-reported anxiety [RCADS-Total Anxiety], and behaviorally-indexed anxiety); the two hypothesized mediators (self-report [CNCEQ-Total] and computerized assessments of interpretation biases [WSAP]) remained constant across all models. Significant indirect effects were determined by examining the 95% bootstrapped confidence intervals (10,000 re-samples) for the indirect effect in each regression. A bootstrap-confidence interval that does not include zero provides evidence of a significant indirect effect (Preacher & Hayes, 2008). Additionally, following recent recommendations (Wen & Fan, 2015), the ratio of the indirect effect to the total effect (i.e., PM, or mediation ratio; Ditlevsen, Christensen, Lynch, Damsgaard, & Keiding, 2005) was reported as a measure of effect size for significant indirect effects.

Results

Preliminary analyses

Means, standard deviations, and correlations among all study variables are presented in Table 1. All variables demonstrated acceptable levels of skewness and kurtosis. EATQ-ATT, EATQ-IC, and EATQ-EC scores were negatively related to CNCEQ-Total and RCADS-Total Anxiety scores (*r*s ranging from -.32 to -.51). EATQ-ATT and EATQ-EC scores were also negatively related to WSAP scores. CNCEQ-Total and WSAP scores were both positively related to RCADS-Total Anxiety scores. Behaviorally-indexed child anxiety ratings were not significantly related to any of the study variables.

Tests of Indirect Effects

Models predicting child self-reported anxiety severity.

***Attentional control*.** There was a significant total effect of EATQ-ATT (b = -14.43, t = -5.87, p = .000, BC 95% CI [-19.31, -9.56]) on RCADS-Total Anxiety scores (see Table 2; Figure 2). There was also a significant negative indirect effect of EATQ-ATT on RCADS-Total Anxiety via CNCEQ-Total (completely standardized point estimate = -.22, SE = .06, BC 95% CI [-.34, -.12]; P_M = .44, SE = .11, BC 95% CI [.26, .68]) but not WSAP (completely standardized point estimate = -.03, SE = .04, BC 95% CI [-.12, .03]). After accounting for indirect effects of the mediators, the direct effect of EATQ-ATT on RCADS remained significant (b = -7.17, t = -3.24, p = .001, BC 95% CI [-11.56, -2.78]).

***Inhibitory Control*.** There was a significant total effect of EATQ-IC (b = -8.60, t = -3.39, p = .001, BC 95% CI [-13.63, -3.57]) on RCADS-Total Anxiety scores (see Table 2; Figure 3). There was also a significant negative indirect effect of EATQ-IC on RCADS-Total Anxiety via CNCEQ-Total (completely standardized point estimate = -.19, SE = .05, BC 95% CI [-.31, -.09]; P_M = .60, SE = 49.82, BC 95% CI [.30, 1.11]) but not WSAP (completely standardized point estimate = -.03, SE = .02, BC 95% CI [-.10, .00]). After accounting for indirect effects of the mediators, the direct effect of EATQ-IC on RCADS-Total Anxiety was no longer significant (b = -2.79, t = -1.37, p = .17, BC 95% CI [-6.82, 1.25]).

***Effortful Control*.** There was a significant total effect of EATQ-EC (b = -17.14, t = -5.98, p = .000, BC 95% CI [-22.82, -11.46]) on RCADS-Total Anxiety scores (see Table 2; Figure 4).

There was also a significant negative indirect effect of EATQ-EC on RCADS-Total Anxiety via CNCEQ Total (completely standardized point estimate = -.24, *SE* = .06, BC 95% CI [-.36, -.14]; P_M = .47, *SE* = .12, BC 95% CI [.27, .76]) but not WSAP (completely standardized point estimate = -.04, *SE* = .04, BC 95% CI [-.12, .02]). After accounting for indirect effects of the mediators, the direct effect of EATQ-EC on RCADS-Total Anxiety remained significant (*b* = -7.86, *t* = -2.03, *p* = .001, BC 95%CI [-13.10, -2.61]).

Models predicting behaviorally-indexed child anxiety.

***Attentional Control*.** The total effect of EATQ-ATT on behaviorally-indexed child anxiety was not significant (*b* = .12, *t* = .84, *p* = .40, BC 95% CI [-.16, .40]; Table 2). The indirect effects of EATQ-ATT on behaviorally-indexed child anxiety via CNCEQ-Total (completely standardized point estimate = -.07, *SE* = .05, BC 95% CI [-.18, .00]) or WSAP (completely standardized point estimate = -.07, *SE* = .05, BC 95% CI [-.18, .01]) were not significant. After accounting for the indirect effects of the mediators, the direct effect of EATQ-ATT on behaviorally-indexed child anxiety was significant (*b* = .32, *t* = 2.03, *p* = .04, BC 95% CI [.01, .62]).

***Inhibitory Control*.** The total effect of EATQ-IC on behaviorally-indexed child anxiety was not significant (*b* = -.07, *t* = -.51, *p* = .61, BC 95% CI [-.33, .20]; Table 2). The indirect effects of EATQ-IC on behaviorally-indexed child anxiety via CNCEQ-Total (completely standardized point estimate = -.04, *SE* = .04, BC 95% CI [-.14, .03]) or WSAP (completely standardized point estimate = -.02, *SE* = .02, BC 95% CI [-.08, .01]) were not significant (see Table 2). After accounting for the indirect effects of the mediators, the direct effect of EATQ-IC on behaviorally-indexed child anxiety was no longer significant (*b* = .01, *t* = .07, *p* = .94, BC 95%CI [-.27, .29]).

Effortful Control. The total effect of EATQ-EC on behaviorally-indexed child anxiety was not significant (*b* = -.11, *t* = -.64, *p* = .52, BC 95% CI [-.43, .22]; Table 2). The indirect effects of EATQ-EC on behaviorally-indexed child anxiety via CNCEQ-Total (completely standardized point estimate = -.06, *SE* = .05, BC 95% CI [-.17, .03]) or WSAP (completely standardized point estimate = -.04, *SE* = .04, BC 95% CI [-.15, .03]) were not significant. After accounting for indirect the effects of the mediators, the direct effect of EATQ-EC on behaviorally-indexed child anxiety was not significant (*b* = .07, *t* = .36, *p* = .72, BC 95%CI [-.31, .44]).

Discussion

The present multi-method investigation examined the mediating role of interpretation biases in the relation between effortful control and anxiety symptom severity in a diverse sample of children with anxiety disorders. Consistent with past studies (Muris et al., 2008) and in partial support of the first hypothesis, effortful control and its subcomponents (attentional control and inhibitory control) were negatively related to *self-reported* child interpretation biases and anxiety symptom severity. Effortful control and attentional control were also negatively related to behaviorally-indexed interpretation biases. These findings suggest that effortful control and its subcomponents may protect against threat-laden interpretation biases and anxiety symptoms among clinically anxious youth. Specifically, an increased ability to shift attention and/or inhibit prepotent responses may allow clinically anxious children to more effectively resist interpreting situations in a threatening manner, which, in theory, may lower risk for anxiety (Gorlin & Teachman, 2015; Salemink & Wiers, 2012; Scheper et al., 2017).

Contrary to expectation, neither effortful control nor its subcomponents were significantly related to *behaviorally-indexed* child anxiety severity (Table 1). . Likewise, none of the multiple mediator models predicting *behaviorally-indexed* child anxiety severity were significant. Several possibilities for this finding are worth noting. First, the parent-child interaction task, during which children's behavioral displays of anxiety were coded, may not have elicited the level of distress that the researchers anticipated. Indeed, the mean score for behaviorally-indexed child anxiety severity was 2.02 (*SD* = 0.93), which corresponds to displays of "a little anxiety" to "some anxiety" on the standardized coding system used (Ginsburg & Grover, 2007; Ginsburg et al., 2006; Ginsburg et al., 2005). Additionally, the modal score was 2, suggesting that the most frequently observed severity of child anxiety during the parent-child interaction task was indeed "a little" [anxiety]. This may have contributed to the lack of significant correlations between effortful control and behaviorally-indexed anxiety. Second, given the nature of the task (children knew they were being videotaped), it is possible that some children may have attempted to hide visible signs of anxiety from the experimenters, resulting in lower observed mean scores of behaviorally-indexed anxiety than expected. Past work has reported on research participants' alteration of their behavior due to their awareness of being observed (i.e., Hawthorne Effect; Diaper, 1990), which poses a threat to internal and external validity (Harris & Lahey, 1982); this, too, may have influenced the magnitude of the relations at the bivariate level. Finally, it is possible that the social nature of the task and the discussion (i.e., preparing for a speech) may not have elicited anxiety among children whose primary concerns were academic worries or a specific phobia (Ginsburg et al., 2006).

Results from multiple mediator models revealed that self-reported (but not behaviorally-indexed) child interpretation biases mediated the relation between effortful control, attentional control, and inhibitory control and self-reported child anxiety symptom severity. These findings are consistent with burgeoning research documenting the role of cognition in the link between temperamental regulatory abilities and anxiety (Gramszlo et al., 2018). Specifically, results suggest that among clinically anxious children, higher levels of effortful control may work in a manner akin to a "break," slowing down the tendency to fall victim to automatic negative thoughts, which in turn, may lower anxiety-related distress. Indeed, research suggests that individuals with low, but not high, inhibitory control are more likely to interpret ambiguous stimuli in a threatening manner (Scheper et al., 2017). Similarly, high attentional control has been found to reduce the risk of anxious temperament on child anxiety symptoms (Gramszlo et al., 2018). The current investigation extends these findings by being the first to specifically investigate the mediating role of interpretation biases in the relation between effortful control, its lower-order components, and anxiety symptom severity in a sample of children with anxiety disorders.

Although it is unclear why behaviorally-indexed child interpretation biases were not a significant mediator in the relation between effortful control (and its subcomponents) and child self-reported anxiety, several explanations warrant mention. First, as seen in Table 1, the correlation between the CNCEQ-Total and RCADS-Total was stronger (r = .68) than the correlation between behaviorally-indexed interpretation biases (WSAP) and RCADS-Total (r = .46). Such differences may be responsible for the increased explanatory power of the CNCEQ in the models. Second, self-reported and behaviorally-indexed measures of interpretation biases shared 26% of the variance, suggesting that these instruments are assessing related—albeit clearly distinct—aspects of interpretation biases. Whereas the CNCEQ measures children's dispositional tendencies to negatively interpret situations, the WSAP is designed to measure the extent to which children quickly select a threatening or non-threatening interpretation to an ambiguous situation. As such, the WSAP may be accessing more automatic, "hot" aspects of biased information processing, whereas the CNCEQ assesses more deliberate, “cold” aspects of information processing (Roiser & Sahakian, 2013).

Several additional findings that were not the focus of the present investigation warrant some comment. First, consistent with past work (Viana et al., 2016; Weems et al., 2001), child self-reported anxiety and interpretation biases (both self-reported and behaviorally-indexed) were significantly positively correlated (rs = .68 and .46 respectively), thereby underscoring the reliability of the interpretation bias measures used herein. Second, when examining the two components of effortful control (i.e., attentional and inhibitory control), attentional control evinced larger effect sizes that did inhibitory control in relation to internalizing symptoms, suggesting that attentional control may be a more salient protective factor. Such proposition is consistent with theory and empirical evidence regarding the role of attentional control in internalizing (vs. externalizing) disorders (Muris & Ollendick, 2005; White et al., 2011). Indeed, research has found that attentional bias towards threat is positively related to anxiety symptoms (White et al., 2011), whereas inhibitory control deficits feature prominently among children with externalizing difficulties (Olson et al., 2011).

The present study is not without limitations. First, due to the cross-sectional nature of the study design, the exact direction of the association among variables cannot be determined with certainty. A longitudinal design is needed and is more apt to elucidate the true temporal sequence among the assessed constructs. Although temperamental constructs such as effortful control, attentional control, and inhibitory control begin to emerge early in development (Kochanska & Knaack, 2003; Posner & Rothbart, 2003; Rothbart & Bates, 1998) and prior to the development of higher-order cognitions (e.g., interpretation biases), it is possible that these relations are bidirectional. Specifically, frequently interpreting situations in a threatening manner may, over time, become the child's default thinking style, overriding opportunities for more deliberate and effortful thinking. Second, the sample was comprised exclusively of clinically anxious children and their clinically anxious mothers. The extent to which the findings generalize to the general population or to children with other forms of psychopathology is unknown. A replication of the present investigation using a sample of children with primary diagnoses of externalizing disorder would be a welcome addition in order to examine the specificity of the findings to anxiety. Third, behavioral measures of effortful, attentional, and inhibitory control were not collected, making it impossible to determine whether children's self-report on their regulatory abilities is consistent with objective indicators of their actual abilities. Indeed, most research concerning effortful control has relied on self-report scales to measure this temperamental trait. Few studies have investigated behavioral measures of effortful control (Kochanska & Knaack, 2003), despite their overlap with executive functioning skills (which are easily assessed with cognitive/neuropsychological performance tasks, such as the Go/No Go Task; Schachar & Logan, 1990). Among the few available studies, Muris, van der Pennen, Sigmond, and Mayer (2008) found small (*r*s between .19 and .24), yet significant correlations between child self-reported attentional control and a behavioral measure of effortful control. Given the relative paucity of behavioral assessment of effortful control, future work should include both self-reported and behavioral effortful control and examine concordance between these methods of assessment. Notably, if children *believe* that they have poor effortful control abilities, but *display* average effortful control skills in a behavioral task, the perception (vs. actual ability) of poor effortful control may be a driving force of anxiety symptom severity.

The present investigation has several clinical implications. First, effortful control has been found to be a malleable construct (Diamond, Barnett, Thomas, & Munro, 2007). Therefore, clinically anxious children who score low in this temperamental dimension could be identified and targeted with intervention aimed at improving their regulatory abilities, which in turn, may protect them from subsequent or more severe difficulties with anxiety. Indeed, recent evidence suggests that cognitive regulatory processes, such as inhibitory control and executive attention, can improve with training among children (Diamond et al., 2007; Rueda, Rothbart, McCandliss, Saccomanno, & Posner, 2005). Specifically, a school curriculum that focused on promoting executive functioning (EF) skills (e.g., inhibitory control, working memory, and cognitive flexibility) was shown to be superior to an "as usual" curriculum. Children randomly assigned to the intervention outperformed the control children in EF tasks, which were also associated with improved academic performance. Second, children with risky temperamental profiles, such as low effortful control, may benefit from Cognitive Bias Modification (CBM) training. CBM training is linked to reduced interpretation biases and reduced internalizing symptoms in both children (Lothmann, Holmes, Chan, & Lau, 2011) and adults (Hallion & Ruscio, 2011). Third, enhancing child attentional control may facilitate redirecting attention away from threat (i.e., interpretation biases), thus reducing anxiety. Attention Bias Modification Treatment (ABMT) has yielded reductions in anxiety of medium effect (d = .61) among adults (Hakamata et al., 2010). Findings in children reflect the same pattern: clinically anxious children who were trained to shift attention away from threat using ABMT showed reductions in the number and severity of anxiety symptoms compared to controls (Eldar et al., 2012). Similarly, ABMT was found to augment Cognitive Behavioral Therapy (CBT) in treatment-seeking children with anxiety disorders compared to CBT alone (Shechner et al., 2014).

Overall, the present investigation found support for child self-reported interpretation biases as an underlying mechanism in the relation between effortful control (and its subcomponents) and subjective reports of child anxiety symptom severity in a large, racially diverse sample of children with anxiety disorders. Models predicting behaviorally-indexed child anxiety severity were not significant, however. Taken together, results from the present investigation suggest that children's effortful control and its subcomponents may potentially reduce the likelihood of interpreting situations in a negative or threatening manner, which may lower their anxiety. Future work should evaluate whether targeting these malleable temperamental constructs leads to clinically meaningful reductions in interpretation biases and child anxiety symptoms.

Table 1

Correlations and descriptive statistics (*N* = 105)

	1	2	3	4	5	6	7	8	9	10	11
1. Age	--										
2. Gender	.13	--									
3. Ethnicity	.05	.12	--								
4. Household income	.11	.10	.31**	--							
5. EATQ-ATT	.10	.02	.07	.08	--						
6. EATQ-IC	.13	.06	.12	.09	.43*	--					
7. EATQ-EC	.12	-.001	.12	.12	.80*	.80*	--				
8. CNCEQ	.16	.16	.06	.08	-.41*	-.33*	-.45*	--			
9. Computer Bias	.02	.15	-.11	.003	-.40*	-.18	-.39*	.51*	--		
10. RCADS-Anxiety	-.05	.15	-.03	.05	-.50*	-.32*	-.51*	.68*	.46*	--	
11. Behavioral Anxiety	.12	.08	.12	.16	.08	-.05	-.06	.17	.17	.12	--
Mean	10.07	1.57	--	7.99	3.34	3.66	3.50	48.45	5.45	29.05	2.02
SD	1.22	.50		3.43	.65	.69	.55	18.05	3.05	18.63	.93

Note.

EATQ-ATT, IC, and EC = Early Adolescent Temperament Questionnaire attentional, inhibitory, and effortful control; CNCEQ = Children's Negative Cognitive Error Questionnaire; RCADS = Revised Children's Anxiety and Depression Scale – total raw anxiety score.

* $p < .001$

Table 2

Multiple mediation results (*N*=105)

	Interpretation Bias	CNCEQ						Computerized Bias					
Y	**Model**	***β***	***SE***	***t***	***p***	**CI(l)**	**CI (u)**	***β***	***SE***	***t***	***p***	**CI(l)**	**CI (u)**
1	EATQ-ATT → Int. Bias (a)	-11.32	2.52	-4.50	.000	-16.31	-6.34	-1.90	.43	-4.44	.000	-2.74	-1.05
	Int. Bias → RCADS (b)	.56	.08	6.61	.000	.39	.73	.49	.50	.99	.32	-.49	1.48
	EATQ-ATT → RCADS (c)	-14.43	2.46	-5.87	.000	-19.31	-9.56						
	EATQ-ATT → RCADS (c’)	-7.17	2.21	-3.24	.002	-11.56	-2.78						
	EATQ-ATT → Int. Bias → RCADS (ab)	-6.33	1.97			-10.82	-2.99	-.94	1.10			-3.50	.93
2	EATQ-IC → Int. Bias (a)	-8.61	2.45	-3.52	.001	-13.47	-3.76	-.79	.43	-1.83	.07	-1.64	.07
	Int. Bias → RCADS (b)	.59	.09	6.71	.000	.42	.77	.88	.50	1.76	.08	-.11	1.88
	EATQ-IC → RCADS (c)	-8.60	2.53	-3.39	.001	-13.63	-3.57						
	EATQ-IC → RCADS (c’)	-2.79	2.04	-1.37	.17	-6.82	1.25						
	EATQ-IC → Int. Bias → RCADS (ab)	-5.12	1.57			-9.05	-2.56	-.70	.67			-2.79	.093
3	EATQ-EC → Int. Bias (a)	-14.67	2.88	-5.10	.000	-20.38	-8.96	-2.14	.50	-4.25	.000	-3.13	-1.14
	Int. Bias → RCADS (b)	.55	.09	6.30	.000	.37	.72	.59	.50	1.19	.24	-.40	1.58
	EATQ-EC → RCADS (c)	-17.14	2.86	-5.98	.000	-22.82	-11.46						
	EATQ-EC → RCADS (c’)	-7.86	2.65	-2.97	.004	-13.10	-2.61						
	EATQ-EC → Int. Bias → RCADS (ab)	-8.02	2.25			-13.26	-4.21	-1.26	1.27			-4.35	.75

4	EATQ-ATT → Int. Bias (a)	.-11.32	2.52	-4.50	.000	-16.31	-6.34	-1.89	.43	-4.44	.000	-2.74	-1.05
	Int. Bias → Beh. Anx (b)	.01	.01	1.52	.13	-.003	.02	.05	.04	1.43	.15	-.02	.12
	EATQ-ATT → Beh. Anx (c)	.12	.14	.84	.40	-.16	.40						
	EATQ-ATT → Beh. Anx (c')	.32	.16	2.03	.04	.01	.62						
	EATQ-ATT → Int. Bias → Beh. Anx (ab)	-.10	.07			-.26	.01	-.10	.07			-.26	.02
5	EATQ-IC → Int. Bias (a)	-8.61	2.45	-3.52	.001	-13.47	-3.76	-.79	.43	-1.83	.07	-1.64	.07
	Int. Bias → Beh. Anx (b)	.01	.01	1.00	.32	-.01	.02	.03	.03	.95	.35	-.04	.10
	EATQ-IC → Beh. Anx (c)	-.07	.13	-.51	.61	-.33	.20						
	EATQ-IC → Beh. Anx (c')	.01	.14	.07	.94	-.27	.29						
	EATQ-IC → Int. Bias → Beh. Anx (ab)	-.05	.05			-.19	.04	-.03	.03			-.12	.02
6	EATQ-EC → Int. Bias (a)	-14.67	2.88	-5.10	.000	-20.38	-8.96	-2.14	.50	-4.25	.000	-3.13	-1.14
	Int. Bias → Beh. Anx (b)	.001	.001	1.08	.28	-.01	.02	.04	.04	1.00	.32	-.03	.11
	EATQ-EC → Beh. Anx (c)	-.11	.17	-.64	.52	-.43	.22						
	EATQ-EC → Beh. Anx (c')	.07	.19	.36	.72	-.31	.44						
	EATQ-EC → Int. Bias → Beh. Anx (ab)	-.10	.09			-.29	.06	-.08	.07			-.25	.05

Note. a = Effect of X on M; b = Effect of M on Y; c = Total effect of X on Y; c' = Direct effect of X on Y controlling for M. ab = indirect effect of X on Y through M. The standard error and 95% CI for *a*b* are obtained by bootstrap with 10,000 re-samples. CI (lower) = lower bound of a 95% confidence interval; CI (upper) = upper bound; → = affects. EATQ-ATT, EATQ-IC, and EATQ-EC (temperamental attentional control, inhibitory control, and effortful control) are the predictors, Interpretation Biases (CNCEQ and Computerized Bias) are the explanatory variables, and Anxiety (RCADS and Behavioral Anxiety) are the outcomes.

Figure 1. Theoretical Model: Child cognitive biases as a potential mediator between effortful control (and its subcomponents) and anxiety symptom severity.

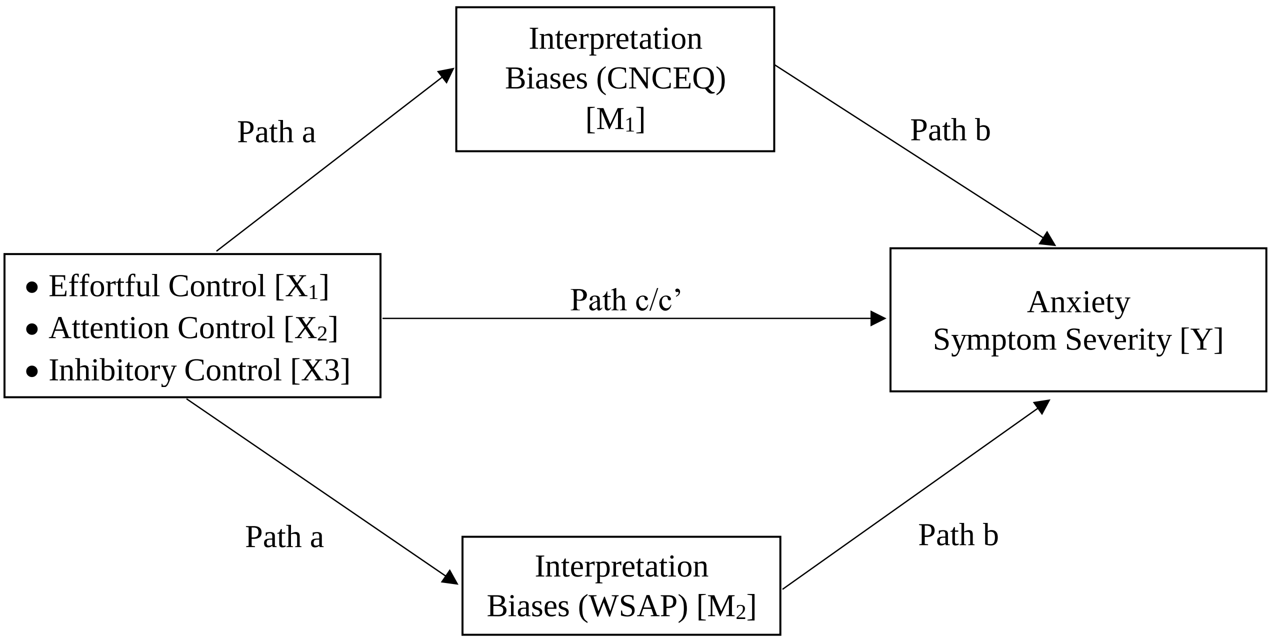
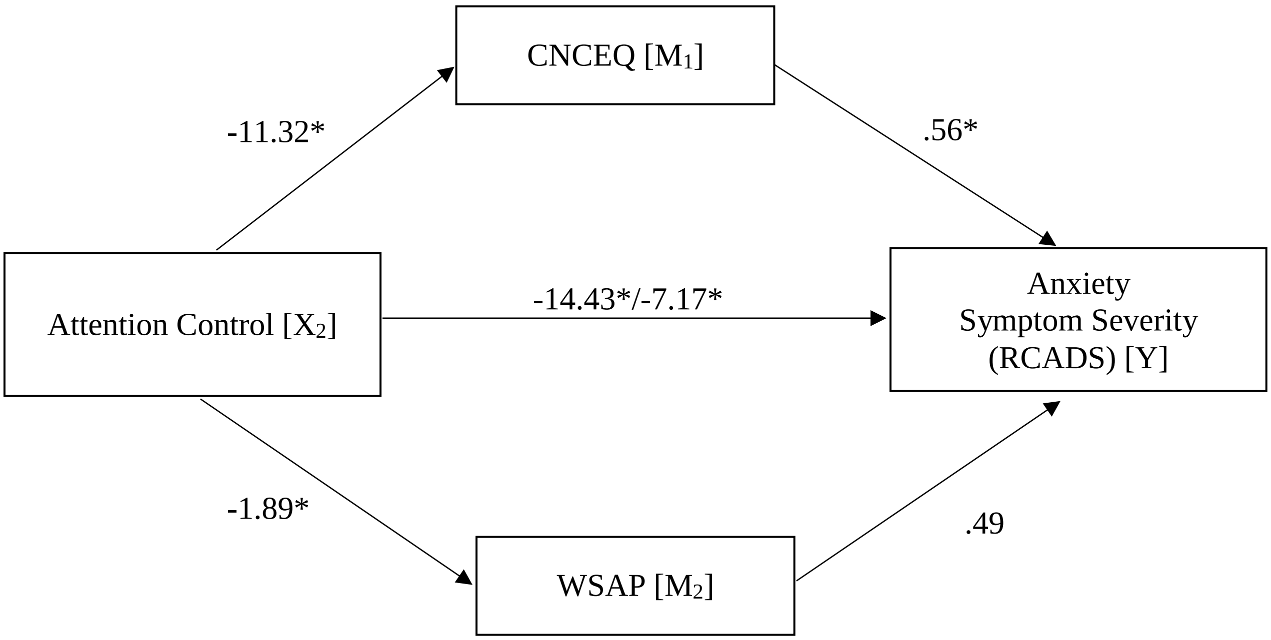
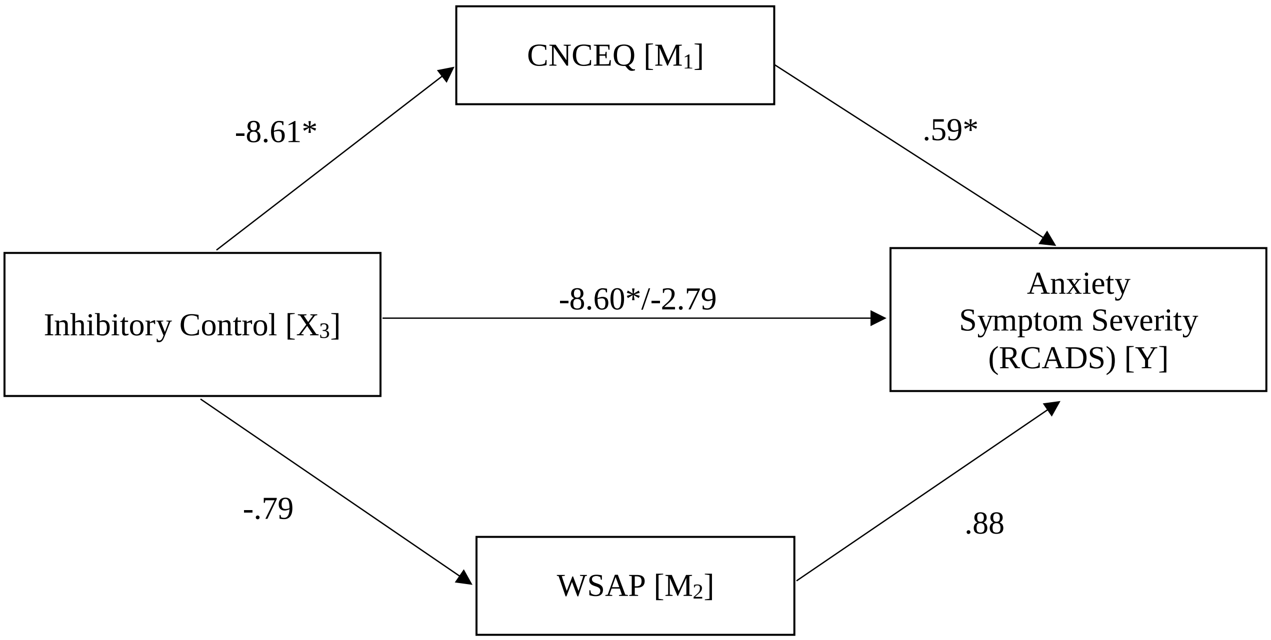


Figure 2. Child interpretation biases as a mediator between attentional control and self-reported anxiety symptom severity.



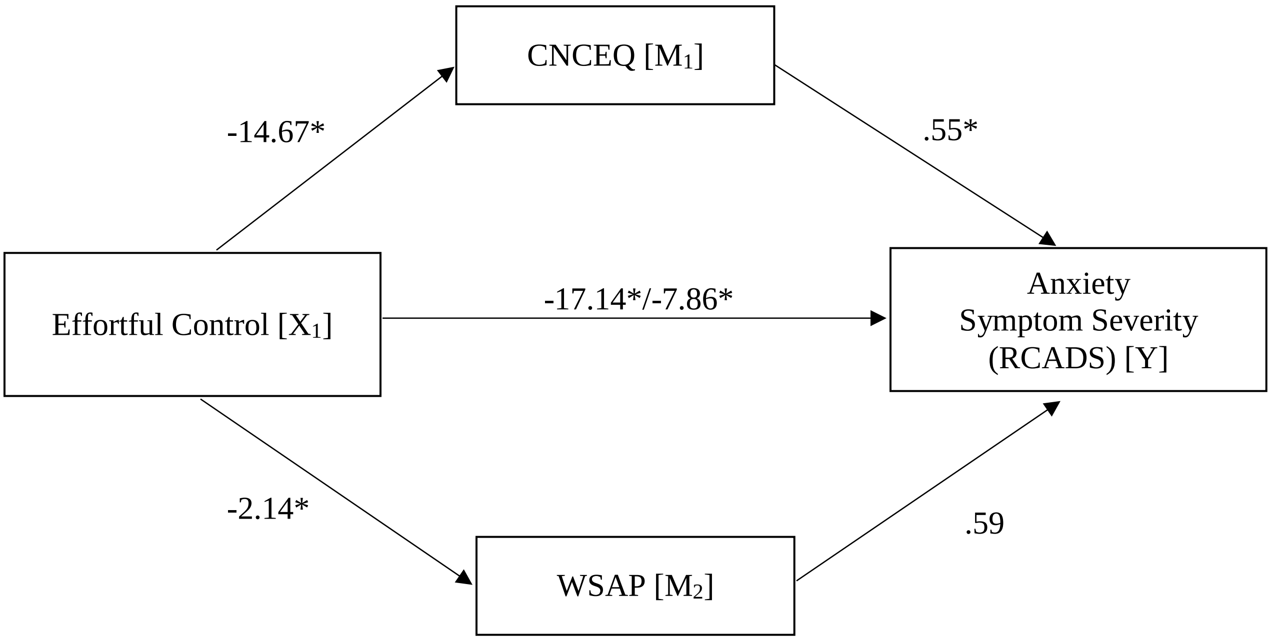
Note. * $p < .001$

Figure 3. Child interpretation biases as a mediator between inhibitory control and self-reported anxiety symptom severity.



Note. * $p < .001$

Figure 4. Child interpretation biases as a mediator between effortful control and self-reported anxiety symptom severity.



Note. * $p < .01$

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