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Effortful control, interpretation biases, and child anxiety symptom severity in a sample of children with anxiety disorders

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ABSTRACT

Introduction: Effortful control—the ability to inhibit impulsive reactions in favor of more adaptive responses—is negatively related to child anxiety severity. One potential explanation is that greater effortful control may "slow down" automatic, threat-laden interpretations, thereby lowering children's anxiety. The present investigation tested this hypothesis by examining associations between effortful control (and its subcomponents) and anxiety symptom severity, mediated by interpretation biases, in a diverse sample of clinically anxious youth.
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 measure of interpretation biases; and a parent–child interaction task for which an index of behavioral anxiety was computed.
Results: Significant indirect effects were found for effortful control, attentional control, and inhibitory control on child self-reported anxiety severity by way of self-reported (but not behaviorally-indexed) interpretation biases. Models predicting *behaviorally-indexed* child anxiety severity were not significant.
Discussion: Greater effortful control may result in enhanced attentional capacities that allow children to assess automatic cognitions more objectively, potentially lowering their anxiety. Future work should evaluate whether targeting malleable temperamental constructs, such as effortful control, leads to clinically meaningful reductions in interpretation biases and child anxiety symptoms.

1. Introduction

Anxiety disorders are one of the most common mental illnesses among children in the United States, 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). A worldwide prevalence rate of 6.5% has been reported among children and adolescents ages 6–18 (Polanczyk, Salum, Sugaya, Caye, & Rohde, 2015). Childhood anxiety disorders are 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). 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 an adaptive response (Lonigan & Vasey, 2009; Rothbart & Bates, 2006)—has been identified as a protective factor against childhood anxiety. To illustrate, consider two students who raise their hand to answer a question in class, yet the teacher does not call on either of them. Because the child with low effortful control has difficulties inhibiting automatic thoughts, he quickly concludes that the teacher dislikes him, which further increases

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his anxiety about contributing to the class discussion. In contrast, the child with high effortful control, although disappointed, is able to inhibit negative thoughts and remind herself that the teacher is just taking turns, which lowers her anxiety. Conceptualized as a temperamental trait, effortful control is thought to be largely innate (Kochanska & Knaack, 2003), with heritability estimates ranging from 68 to 79% (Lemery-Chalfant, Doelger, & Goldsmith, 2008), and is thought to develop progressively as a result of brain maturation and environmental influences (Posner & Rothbart, 2003; Rothbart & Bates, 1998). Neuroimaging data, as well as findings from neuropsychological tasks targeting the anterior attentional system (Davis, Bruce, & Gunnar, 2002; Posner, 1995), corroborate the rapid development of these skills in childhood (Carlson & Moses, 2001; Morasch & Bell, 2011).

Individual differences in effortful control, as well as its developmental precursors (e.g., infant orienting/regulation; Bridgett et al., 2011), are observed in infancy (Bridgett et al., 2011) and are positively predictive of later effortful control abilities (Kochanska, Murray, & Harlan, 2000). Indeed, 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 et al., 2002; Kochanska et al., 2000).Studies of toddlers have reported that effortful control at 22 months significantly predicted effortful control at 33 (Kochanska et al., 2000) and 45 months, respectively (Kochanska & Knaack, 2003; Murray & Kochanska, 2002). A separate investigation of 1155 children between ages 4.5 and 10.5 years found significant stability of self-control over a 6-year period (Vazsonyi & Huang, 2010). Toddlers' abilities to exercise self-restraint were also predictive of inhibitory and attentional control at age 17 years (Friedman, Miyake, Robinson, & Hewitt, 2011). Together, these findings suggest that effortful control is a fairly stable construct across childhood and adolescence.

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). Research has found that high effortful control as well as its subcomponents are protective against psychopathology (White, McDermott, Degnan, Henderson, & Fox, 2011), whereas deficits in this self-regulatory construct are related to greater mental health problems (Eisenberg, Hofer, & Vaughan, 2007; Niditch & Varela, 2018), including anxiety disorders (Muris & Ollendick, 2005). Moreover, there is support for examining the subcomponents of effortful control separately (i.e., attentional and inhibitory control) in investigations of child psychopathology. For example, studies have found that attentional control may be more relevant to internalizing difficulties (e.g., anxiety; Muris & Ollendick, 2005; White et al., 2011), whereas deficits in inhibitory control may be more strongly associated with externalizing disorders (e.g., ADHD; Muris & Ollendick, 2005; Olson et al., 2011).

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 sample of 216 children ages 3–7, Scheper et al. (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). These findings are consistent with theory suggesting that children's ability to regulate goal-directed, top-down attentional capacities, and more specifically effortful control, is inversely related to later psychopathology (Muris & Ollendick, 2005). However, despite the robust associations between low effortful control and child anxiety symptom severity found in the extant literature (Lonigan & Vasey, 2009; Muris & Ollendick, 2005; Niditch & Varela, 2018), the cognitive mechanisms explaining these associations are poorly understood. This is surprising, given burgeoning evidence for the role of cognition as one potential link between temperamental risk for anxiety and the development of anxiety disorders (Pérez-Edgar et al., 2010; Viana & Gratz, 2012), as well as existing theories regarding the role of goal-directed (top-down) attentional control on cognitive performance and anxiety-related phenomena (Eysenck, Derakshan, Santos, & Calvo, 2007).

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 (Beck, Emery, & Greenberg, 2005), 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, 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). For example, in 251 youth with anxiety disorders, catastrophizing, overgeneralization, and personalizing were correlated with trait anxiety, anxiety sensitivity, and manifest anxiety while controlling for children's levels 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).

Additionally, experimental investigations have reported that anxious children provide more threatening interpretations to ambiguous vignettes than do controls (Barrett, Rapee, Dadds, & Ryan, 1996; Chorpita, Albano, & Barlow, 1996). Longitudinal research has also found associations between interpretation biases and anxiety symptom maintenance over time (Creswell & O'Connor, 2011; Dodd, Hudson, Morris, & Wise, 2012). Clinical trials also 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). A recent meta-analysis of interpretation biases in children and adolescents reported medium-size associations between negative interpretations and child anxiety symptoms (d = .62; Stuijfzand, Creswell, Field, Pearcey, & Dodd, 2018).

Although promising, past work on interpretation biases 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 lack of research is surprising given that effortful control and/or its subcomponents (i.e., inhibitory control and attentional control) are reliably associated with *both* interpretation biases 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 et al. (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). Indeed, shifting attention away from threat in the environment was related to lower anxiety, even among youth already at-risk for anxiety due to their temperamental profiles (White et al., 2011).

Notably, an extensive developmental literature suggests that individual differences in temperament emerge before cognitive processes such as interpretation biases are observable. Indeed, temperamental characteristics in general are theorized to have early developmental origins (e.g., Kagan, 2008), and cognitive biases are thought to emerge later in development (White, Helfinstein, & Fox, 2010). Thus, early-emerging individual differences in effortful control may potentially provide protection against the development of interpretation biases (Bridgett et al., 2011; Kochanska et al., 2000), as greater effortful control is related to goal-directed (top-down) attentional capacities (Derakshan & Eysenck, 2009; Eysenck et al., 2007), the anterior attention system and indices of executive attention (Rothbart, Sheese, & Posner, 2007; Ruff & Rothbart, 2001; Simonds, Kieras, Rueda, & Rothbart, 2007). These enhanced attentional capacities (due to greater effortful control), in turn, may allow children to assess automatic cognitions more objectively, potentially lowering their anxiety. Given this evidence, and consistent with theoretical models linking temperamental vulnerabilities to anxiety through their association with cognitive biases (see Fox, Park, & Lang, 2007), a model in which greater effortful control is indirectly related to lower anxiety severity by way of interpretation biases warrants examination.

1.1. The present study

The present study examined whether multi-method assessments of interpretation biases undergirded the association between effortful control and child anxiety symptoms in a sample of children with anxiety disorders (see Fig. 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 indirect effects. However, given the paucity of data, no specific hypotheses were made with respect to the relevance of one subcomponent over the other in tests of indirect effects.

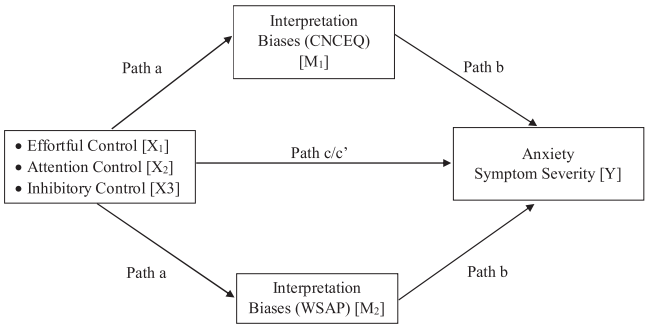

Fig. 1. Theoretical Model: Child cognitive biases as a potential mediator between effortful control (and its subcomponents) and anxiety symptom severity.

2. Method

2.1. Participants

The present study involved secondary analysis of data from a federally-funded study 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 years, (b) the child had a primary anxiety disorder diagnosis (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 study involved evaluating the effect of a computerized intervention targeting maternal cognitions, mothers were excluded if they were currently involved in cognitive behavioral therapy (CBT) for anxiety (which explicitly targets cognitions) and/or if they had changes in their pharmacological treatment (for anxiety) within 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: 38.1% White, 28.6% Hispanic, 17.1% mixed ethnicity, 14.3% African American, and 1.9% Asian American. Twenty-three percent of families reported an annual household income of < $40,000, 16.0% between $40,000–$69,999, 22.0% between $70,000–$99,999, 36.0% 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's 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%).

2.2. Procedure

All procedures were approved by the local 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 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.

Informed consent from mothers and informed assent from children were obtained at the first session. 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, an experimenter assisted the child in completing a computerized interpretation bias task (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 (this task was subsequently coded to generate a behavioral index of child anxiety; see Measures). The experimenter instructed the mother and the child to take 5 min to prepare for a speech that the child would give about his/her family. The experimenter gave the family an opportunity to ask questions and subsequently left the room for 5 min. After completing the interaction, the mother left 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 min 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.

2.3. Measures

2.3.1. Diagnostic interview

2.3.1.1. MINI international neuropsychiatric interview for children and adolescents (MINI-Kid; Sheehan et al., 1998). The MINI-Kid is a structured diagnostic interview for children from 6 to 17 years old based on DSM-5 psychiatric disorders. 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 second author during team meetings to confirm diagnoses.

2.3.1.2. 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 were the same as that described above. All psychiatric assessments were reviewed by the second author during team meetings to confirm diagnoses.

2.3.2. Effortful control

2.3.2.1. 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. Items are rated on a 5-point Likert scale, ranging from 1 (*almost never true*) to 5 (*almost always true*). 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"), 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") 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).

2.3.3. Interpretation biases

2.3.3.1. Children's negative cognitive error questionnaire (CNCEQ; Leitenberg, Yost, & Carroll-Wilson, 1986). The CNCEQ is a 24-item self-report measure that assesses the degree to which children interpret events in an overly negative manner. 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). The CNCEQ has demonstrated acceptable internal consistency, test–retest reliability, and construct validity estimates (Leitenberg et al., 1986; Weems et al., 2001). In this study, the CNCEQ total score (α = .93) was used as a self-report measure of interpretation biases.

2.3.3.2. Word-sentence association paradigm. (WSAP; Beard & Amir, 2009). Children completed a modified version of the WSAP as a behaviorally-indexed assessment of interpretation biases. The task was programmed using DirectRT version 2012 (Jarvis, 2012) and displayed on a 17-inch 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 was 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 computer key as quickly and accurately as possible. The child was instructed to respond quickly in an attempt to assess interpretation biases in "real-time" (vs. more deliberate forms of interpretation). The stimuli remained on the computer screen until the child responded and reaction times were recorded; 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. The Word Sentence Association Paradigm task is a reliable and valid instrument for assessing interpretive biases in adults (see Gonsalves, Whittles, Weisberg, & Beard, 2019, for a review) as well as children (Viana et al., 2016).

2.3.4. Anxiety symptoms

2.3.4.1. 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) anxiety disorder and major depressive disorder symptoms. 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"). 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 (α = .95) was used in the current study as an index of anxiety disorder symptom severity.

2.3.4.2. 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, & Ialongo, 2005; Ginsburg, Grover, Cord, & Ialongo, 2006). Anxious behaviors (e.g., expresses fear, worry, and perfectionism) 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). Anxious behavior 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. The overall anxiety rating was used as the measure of behaviorally-indexed anxiety in this study. All coders were trained by coding five "gold standard" tapes coded by the second author; 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).

2.4. Data analytic plan

First, variables' distributions were examined 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 were missing randomly or non-randomly. Second, correlational analyses were used to examine associations among study variables and to identify possible sociodemographic covariates. Third, the PROCESS macro for SPSS (Hayes, 2012) was used to examine the multiple 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., P_M, or mediation ratio; Ditlevsen, Christensen, Lynch, Damsgaard, & Keiding, 2005) was reported as a measure of effect size for significant indirect effects.

3. Results

3.1. 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.

3.2. Tests of indirect effects

3.2.1. Models predicting child self-reported anxiety severity

There were significant total effects of attentional control (b = −14.43, 95% CI [−19.31, −9.56], R^2 = .25), inhibitory control (b = −8.60, 95% CI [−13.63, −3.57], R^2 = .10), and effortful control (b = −17.14, 95% CI [−22.82, −11.46], R^2 = .26), on RCADS-Total Anxiety scores (see Table 2; Figs. 2–4). There were also significant negative indirect effects of attentional control (completely standardized point estimate = −.22, *SE* = .06, 95% CI [−.34, −.12]; P_M = .44, *SE* = .11, 95% CI [.26, .68]), inhibitory control (completely standardized point estimate = −.19, *SE* = .05, 95% CI [−.31, −.09]; P_M = .60, *SE* = 49.82, 95% CI [.30, 1.11]), and effortful control (completely standardized point estimate = −.24, *SE* = .06, 95% CI [−.36, −.14]; P_M = .47, *SE* = .12, 95% CI [.27, .76]), on RCADS-Total Anxiety via CNCEQ-Total. Indirect effects of attentional control, inhibitory control, and effortful control on RCADS-Anxiety Total via WSAP were not significant. After accounting for indirect effects of the mediators, the direct effects of attentional control (b = −7.17, 95% CI [−11.56, −2.78]) and effortful control (b = −7.86, 95%CI [−13.10, −2.61]), on RCADS-Anxiety Total remained significant. However, after accounting the direct effect of inhibitory control on RCADS-Total Anxiety was no longer significant (b = −2.79, 95% CI [−6.82, 1.25]).[1]

3.2.2. Models predicting behaviorally-indexed child anxiety

The total effects of attentional control, inhibitory control, and effortful control on behaviorally-indexed child anxiety were not significant (Table 2). The indirect effects of attentional control, inhibitory control, and effortful control on behaviorally-indexed child anxiety via CNCEQ-Total or WSAP were not significant. After accounting for the indirect effects of the mediators, the direct effect of inhibitory control and effortful control on behaviorally-indexed child anxiety were not significant; however, the direct effect of attentional control on behaviorally-indexed child anxiety was significant (b = .32, 95% CI [.01, .62]).

4. Discussion

The present multi-method investigation examined the underlying 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 are negatively associated with 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 was significant. Several possible explanations for this finding are worth noting. First, the parent–child interaction task may not have elicited the anticipated level of distress. Indeed, the mean (M = 2.02; SD = .93) and modal scores of behaviorally-indexed anxiety corresponded to displays of "a little anxiety" to "some anxiety" on the coding system used (Ginsburg & Grover, 2007; Ginsburg et al., 2005, 2006). Second, given that children knew that they were being videotaped, it is possible that some children attempted to hide visible signs of anxiety from the

[1] Given that past work has also conceptualized effortful control as a moderator of cognitive biases-anxiety associations (e.g., Susa-Erdogan et al., 2016), we tested a model in which effortful control moderated interpretation biases-anxiety severity associations. Although the overall model was significant, (F [3, 101] = 37.34, p < .001), the interaction between child interpretation biases (CNCEQ) and effortful control (EATQ-RS) predicting anxiety severity (RCADS) was not significant (p = .204). We thank an anonymous reviewer for this suggestion.

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. WASAP	.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	3.5	48.45	5.45	29.05	2.02
SD	1.22	0.50		3.43	0.65	0.69	0.55	18.05	3.05	18.63	0.93

Note. Gender: 0 = male, 1 = female; 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.

* $p < .01$.

** $p < .001$.

Table 2
Tests of Indirect Effects (N = 105).

	Interpretation Bias	CNCEQ						WASAP					
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.

experimenters, resulting in lower observed mean scores 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). 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). These possibilities may have contributed to the lack of significant correlations between effortful control and behaviorally-indexed anxiety. Of note, the direct effect of attentional control on behavioral anxiety after controlling for both measures of interpretation biases was significant and positive. Given that behavioral anxiety was not related to any study variable at the bivariate level, further replication is needed before firm conclusions can be made about this finding.

Results from multiple mediator models revealed that self-reported

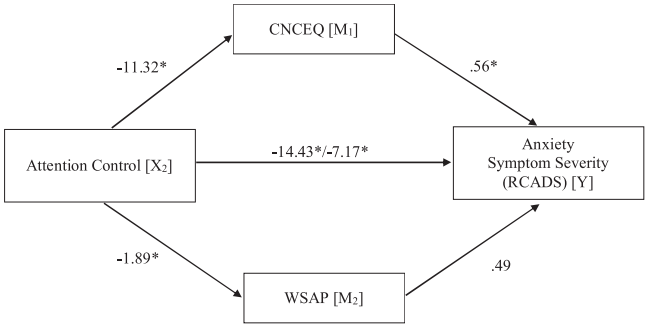

Fig. 2. Child interpretation biases as a mediator between attentional control and self-reported anxiety symptom severity.
Note. * $p < .001$.

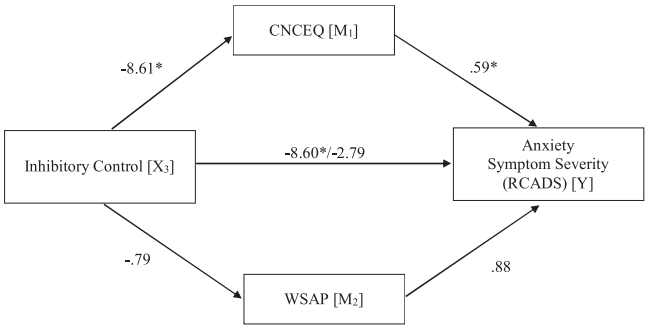

Fig. 3. Child interpretation biases as a mediator between inhibitory control and self-reported anxiety symptom severity.
Note. * $p < .001$.

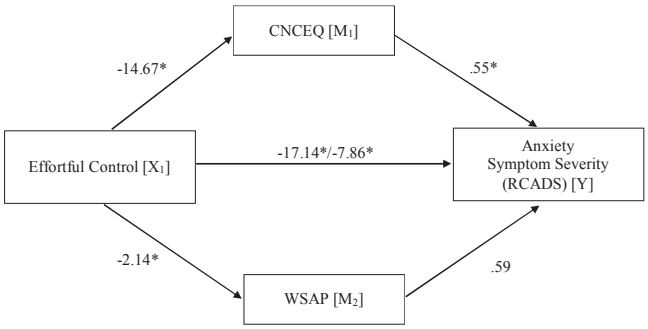

Fig. 4. Child interpretation biases as a mediator between effortful control and self-reported anxiety symptom severity.
Note. * $p < .01$.

(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, Geronimi, Arellano, & Woodruff-Borden, 2018). Specifically, higher levels of effortful control may be associated with enhanced (top-down) regulation of attention that allows children to shift attention from, or inhibit, automatic negative thoughts. In essence, higher effortful control may allow children to take an earlier "off-ramp exit" before engaging in negative thoughts. This process, 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, given that the indirect effects were only significant for rating scales (and not behavioral measures), common-method variance could have influenced the results. However, as seen in Table 1, the correlation between the CNCEQ-Total and RCADS-Total was stronger than the correlation between behaviorally-indexed interpretation biases (WSAP) and RCADS-Total. Such differences may be responsible for the increased explanatory power of the CNCEQ. 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 comment. First, consistent with past work (Viana et al., 2016; Weems et al., 2001), child self-reported anxiety was significantly related to both measures of interpretation bias, thereby underscoring the validity of the measures used herein. Second, when examining the two components of effortful control (i.e., attentional and inhibitory control), attentional control evinced larger effect sizes than did inhibitory control in relation to internalizing symptoms, suggesting that attentional control may be more strongly (negatively) associated with anxiety. 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).

4.1. Limitations

The present study has several limitations. First, the cross-sectional design precludes determining the exact direction of the association among variables. A longitudinal design would be more apt to elucidate the temporal sequence among the assessed constructs. Although temperamental constructs such as effortful control, attentional control, and inhibitory control 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. 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 et al. (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.

4.2. Clinical implications

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 effortful control. More specifically, by enhancing effortful control, and thus top-down regulation attentional capacities, children may be better equipped to shift attention away from, or inhibit, negative automatic thoughts (e.g., interpretation biases), which may lower their 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 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 executive functioning 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 training; these interventions have been 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 reduce the severity of child anxiety symptoms. For example, 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 showed reductions in the number and severity of anxiety symptoms compared to controls (Eldar et al., 2012). Similarly, ABMT was found to augment CBT in treatment-seeking children with anxiety disorders compared to CBT alone (Shechner et al., 2014). Notably, recent investigations of ABMT have found that training towards non-threat, training towards threat, and no-contingency conditions were all associated with decreases in anxiety among adults with social anxiety (Heeren, Mogoaşe, McNally, Schmitz, & Philippot, 2015); a similar pattern was found among youths with treatment-resistant anxiety disorders, wherein improvements in anxiety were reported for both ABMT and attention control conditions (Pettit et al. in press). Thus, it may be that repeated training in focusing, sustaining, and shifting attention may improve self-regulation and enable youth to use their attention effectively to modulate their anxiety.

4.3. Conclusions

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. Results suggest that children's effortful control and its subcomponents may reduce the likelihood of interpreting situations in a negative or threatening manner, which may lower their anxiety symptom severity.

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