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But what will the results be?: Learning to tolerate uncertainty is associated with treatment-produced gains*

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ABSTRACT

The current study examined the association between changes in intolerance of uncertainty (IU) and treatment outcomes for anxious youth. Participants were youth ages 7 to 17 who received cognitive behavioral therapy for anxiety ($N = 73$). Youth and their primary caregivers completed a diagnostic interview and self- and parent-report measures at pre- and post-treatment, including the Intolerance of Uncertainty Scale for Children (IUS-C/P; Przeworski, 2006), the Coping Questionnaire (CQ-C/P; Kendall, 1994) and the Multidimensional Anxiety Scale for Children (MASC-C/P; March et al., 1997). Hierarchical regression analyses evaluated the role of change in IU (the IUS-C/P) in predicting changes in functional impairment, coping efficacy, and anxiety severity post-treatment, controlling for demographic variables (age and gender), and baseline levels of IU, anxiety severity, functional impairment, and coping efficacy. Results demonstrated that treatment was associated with improvements across child-, parent- and clinician-report, and decreased IU from pre- to post-treatment was associated with (a) decreased functional impairment, (b) increased coping efficacy and (c) decreased anxiety severity. The findings indicate that a greater reduction in IU over treatment is associated with better outcomes in children and adolescents with anxiety across informants, suggesting the possibility that an increased focus on IU during treatment for youth anxiety may improve treatment outcomes. Future research should assess the causality of this relationship.

Anxiety disorders are highly prevalent among children and adolescents, with rates estimated to be between 10% and 32% (Costello et al., 2003; Merikangas et al., 2010). These disorders typically persist into adulthood if left untreated (Costello et al., 2003; Pine et al., 1998) and are associated with a myriad of other problems (Swan & Kendall, 2016), including impairments in psychosocial functioning (Langley et al., 2004), poor educational achievement (Woodward & Fergusson, 2001), and increased rates of suicidal ideation (O'Neil et al., 2012). Effective treatment of anxiety disorders in children and adolescents reduces some of these negative sequelae (Benjamin et al., 2013; Silk et al., 2019; Swan & Kendall, 2016; Wolk et al., 2015).

Studies support the efficacy of cognitive behavioral therapy (CBT) for children and adolescents with anxiety (Kendall et al., 2008; Silverman et al., 2008; Walkup et al., 2008) and thus CBT has been deemed a "well established" intervention for treating youth anxiety (Hollon & Beck, 2013). CBT has been found to both reduce anxiety and related symptoms (e.g., Walkup et al., 2008) and increase the ability of youth to cope with anxiety-provoking situations (e.g. Kendall et al., 2016). Anxiety is a necessary emotion that everyone experiences (Rosen & Schulkin, 1998), but youth with an anxiety disorder experience more severe and impairing anxiety. An increase in coping efficacy (i.e. self-perceived ability to handle anxiety-provoking situations) helps these youth feel better when they inevitably experience anxiety. Treatment-produced decreases in anxiety and increases in coping efficacy have been linked to the improved functional outcomes. Treatment gains are often maintained for years following treatment (In-Albon & Schneider, 2007; Kendall, 2012; Kendall & Southam-Gerow, 1996) and have important long-term benefits (Benjamin et al., 2013; Kendall et al., 2004; Kendall & Southam-Gerow, 1996; Wolk et al., 2015). Yet some youth do not benefit from CBT and remain symptomatic (Ginsburg et al., 2011). Consequently, it is important to understand the active mechanisms of the intervention, predictors of differential outcome, and whether targeting these factors might improve treatment outcomes.

Intolerance of uncertainty (IU) is a cognitive feature associated with

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pathological anxiety (Buhr & Dugas, 2002; Dugas & Koerner, 2005; Holaway et al., 2006). IU has been defined as "an individual's dispositional incapacity to endure an aversive response triggered by the perceived absence of salient, key, or sufficient information, and sustained by the associated perception of uncertainty" (Carleton, 2016b, p. 31). Carleton (2016a) proposed that IU is derived from the fear of the unknown (FOTU), a fundamental fear that drives anxiety in various contexts. Higher-order anxieties (e.g., anxiety regarding taking an exam) can often be broken down to FOTU (Carleton, 2016a).

Early theoretical models of IU proposed that the inability to tolerate uncertainty triggers worry and is associated with negative problem orientation, cognitive avoidance and distress, which are key features of Generalized Anxiety Disorder (GAD; Dugas et al., 1998; Dugas & Koerner, 2005). IU is further associated with negative interpretation of ambiguous events (Dugas et al., 2005) and experimental manipulations of IU have been found to increase worry and anxiety (Ladouceur et al., 2000; Meeten et al., 2012). Research indicates that IU has a transdiagnostic influence, contributing to the maintenance of a variety of different anxiety and related disorders in adults, including GAD, Panic Disorder, Social Anxiety Disorder (SocAD), and Obsessive-Compulsive Disorder (see Carleton, 2016b). Transdiagnostic models suggest that the inability to tolerate uncertainty leads to a variety of maladaptive cognitive, emotional, and behavioral coping strategies (e.g., worry, doubt, distress, avoidance, checking, etc.) that are characteristic of many anxiety disorders.

The current literature on IU has expanded from its original research focused in adult populations to now examine IU in children and adolescents. IU in youth is associated with the development of several anxiety disorders, both future-oriented (i.e., GAD, OCD) and present-oriented (i.e., social anxiety, panic disorder; Cornacchio et al., 2018). IU has been found to have a relationship with anxiety and worry in both children and adolescents (Fialko et al., 2012; Osmanağaoğlu et al., 2018), though the literature demonstrates that IU may play a potentially different role in adolescents than in children (Kertz & Woodruff-Borden, 2013). In adolescents, IU can act as a vulnerability factor for positive beliefs about worry and cognitive avoidance, both of which exert an increasing influence on anxiety with age (Fialko et al., 2012). Developmental considerations potentially impact a child's experience regarding his/her worries (Kertz & Woodruff-Borden, 2013). As children develop, FOTU is high; however, exposure to different contexts and events decrease FOTU and increase a child's appropriate risk-taking behavior (Shihata et al., 2016).

A recent meta-analysis of 31 studies examining the association between IU and anxiety in youth found that 36.00% and 39.69% of the variance in anxiety and worry, respectively, was accounted for by IU (Osmanağaoğlu et al., 2018). The role IU plays in anxiety acquisition suggests that IU may be an important predictor of anxiety treatment response. Keefer and colleagues (2017) demonstrated that IU predicted clinical levels of anxiety in youth with Autism Spectrum Disorder (ASD), and they suggested that addressing IU in treatment may have positive implications for outcomes. In adults, CBT for anxiety has been associated with reductions in IU (Dugas et al., 2003; Ladouceur, Dugas, et al., 2000), and reductions in IU following CBT have been found to relate to reductions in anxiety (Boswell et al., 2013; Mahoney & McEvoy, 2012). Specific treatments that target IU in adults have demonstrated efficacy in reducing anxiety and IU (Hewitt et al., 2009; Ladouceur, Dugas, et al., 2000; Ladouceur, Gosselin, et al., 2000; van der Heiden, Muris, & van der Molen, 2012), with a strong relationship between treatment outcomes and change in IU (Dugas & Ladouceur, 2000). However, disorders can present differently at various points in development (American Psychiatric Association, 2013), indicating that research is needed to further clarify the associations between IU and treatment outcomes in anxious youth.

A greater understanding the role of IU in youth anxiety could provide important insight into the mechanisms of treatment and guide interventions for youth who currently do not fully benefit from CBT. For example, it may be important in the treatment of non-responding youth to elicit uncertainty during exposures to provide them with the opportunity to tolerate uncertainty (and develop a non-negative association with uncertainty). According to the inhibitory learning explanation of exposure (Craske et al., 2012; Craske et al., 2014), eliciting uncertainty in the absence of a negative outcome would allow youth to form a new association indicating that uncertainty does not necessarily predict negative outcomes. Targeting IU in treatment also would allow for youth to challenge their negative beliefs about uncertainty (e.g., the belief that uncertainty will lead to negative outcomes; Shihata et al., 2016). Researchers have postulated the importance of addressing IU in the context of CBT treatment for anxiety (Carleton, 2016a; Cornacchio et al., 2018; Cowie et al., 2018; Shihata et al., 2016), and given the role IU may play in the acquisition and maintenance of worry and anxiety in youth, targeting IU in CBT may identify ways to improve treatment and reduce the number of non-responders.

The present study examined the relationship between changes in IU and treatment outcome, specifically (a) functional impairment, (b) coping efficacy and (c) anxiety severity. Because past research has documented gender differences in the relationship between IU and anxiety (Fialko et al., 2012; Thielsch et al., 2015) and because youth age may impact their self-report of IU, coping and anxiety (Comer et al., 2009; Klein, 1991), we hypothesized that decreases in IU would be associated with (a) decreases in functional impairment, (b) increases in coping efficacy, and (c) decreases in anxiety severity beyond the role of gender and age. Additionally, as the study design did not allow for the control of baseline differences in variables of interest, we examined whether the relationship between IU and treatment outcomes held controlling for the effects of pre-treatment functional impairment, anxiety severity, coping efficacy, and IU.

1. Method

1.1. Participants

Participants were 73 youth aged 7 to 17 (M_{age} = 11.56, SD = 2.89 years; 34 females; 79.5% Caucasian) who completed CBT for youth anxiety at the Child and Adolescent Anxiety Disorders Clinic (CAADC), an outpatient clinic at Temple University. Participants came from community referrals in the greater Philadelphia area. Youth were eligible to participate if they met criteria for a DSM-5 principal diagnosis of an anxiety disorder. Principal and co-principal anxiety diagnoses included GAD (n = 47), SepAD (n = 5), SocAD (n = 31), Specific Phobia (SP; n = 10) and/or Anxiety NOS (n = 1).

1.2. Measures

Association of Intolerance of Uncertainty and Youth Treatment Outcome

1.2.1. Intolerance of Uncertainty Scale, Child and Parent Version (IUS-C/P; Przeworski, 2006)

The IUS-C/P is a self- and parent-report measure of how unacceptable and aversive a youth finds uncertainty (e.g. "At all times I want to know how things will turn out;" "I do not like it when I do not know what will happen"). The measure has 34 items to which the individual answers on a 5-point scale how much he/she feels the sentence describes him/her (1 = "Not like me at all" and 5 = "A lot like me") or, on the parent version, describes his/her child. Higher scores reflect more difficulty tolerating uncertainty. The IUS-C and IUS-P have demonstrated internal consistency (α = 0.94 and α = 0.95, respectively) as well as convergent validity (significantly correlated r = 0.67 to r = 0.41 with measures of anxiety) and divergent validity (not significantly correlated with many externalizing measures; Przeworski, 2006). The measure was completed by each youth and parent pre- and post-treatment, with internal consistency in the current sample of

α = 0.93 and α = 0.96 for child- and parent-report, respectively.

1.2.2. Children's Global Assessment Scale (CGAS; Shaffer et al., 1983)

The CGAS is a one-item clinician-rated scale assessing the functional impairment associated with youth anxiety following and informed by the completion of the full diagnostic interview. The CGAS ranges from 1 to 100, with lower scores indicating worse functioning and thus greater functional impairment. This measure has standardized guidelines for clinicians and has demonstrated inter-rater reliability (Shaffer et al., 1983). The CGAS has also been demonstrated to have retest reliability as well as discriminant and concurrent validity (Shaffer et al., 1983). This measure was completed by the diagnosticians pre- and post-treatment.

1.2.3. Coping Questionnaire, Child and Parent Version (CQ-C/P; Kendall, 1994)

The CQ-C/P is an individualized three-item youth- and parent-rated measure of the youth's ability to cope with his/her three most feared situations. Based on information obtained during the clinical diagnostic interview, clinicians identify three areas of greatest difficulty specific to that child or adolescent. The measure asks how well the youth is able to help herself/himself feel less upset (1 = "Not at all able to help"; 7 = "Totally able to help myself") for each of the three feared situations. Higher scores indicate greater coping efficacy. The CQ-C/P has been demonstrated sensitivity to treatment effects (Kendall, 1994) and to have internal consistency and retest reliability (Lau et al., 2010). The measure was completed by each youth and primary caregiver pre- and post-treatment and, although the three items assess different situations, demonstrated internal consistency in the current sample of α = 0.56 and α = 0.83 for child- and parent-report, respectively.

1.2.4. Anxiety Disorders Interview Schedule for DSM-5 Child and Parent Versions (ADIS-5-C/P; Albano & Silverman, in press)

The ADIS-5-C/P is a diagnostician administered semi-structured interview for the diagnosis of anxiety and other related disorders in youth, completed separately by the youth and the parents. Composite diagnoses are established for each child/adolescent by using information from both the youth and the parent interviews. The ADIS-5-C/P determined diagnoses and study eligibility. The ADIS-5-C/P is an update from the ADIS for DSM-IV – Child and Parent Versions (ADIS-IV-C/P; Silverman & Albano, 1996) to be consistent with the minor changes in anxiety disorders between DSM-IV and DSM-5. The ADIS-IV-C/P has demonstrated strong psychometric properties including convergent and discriminant validity (Wood et al., 2002), as well as retest reliability (Silverman et al., 2001). Prior to administering the ADIS-5-C/P, diagnosticians completed reliability training to ensure accuracy and consistency of diagnoses across raters and achieved high inter-rater reliability (ICC > 0.90).

1.2.5. Multidimensional Anxiety Scale for Children Child and Parent Versions (MASC-C/P; March et al., 1997)

The MASC-C/P is a 39-item youth- and parent-report measure of the frequency of youth anxiety symptoms in the past two weeks (1 = "never"; 4 "often"). For the current study, responses were averaged to yield a total score, with higher scores indicating greater youth anxiety severity. The MASC has demonstrated internal reliability (with α ranging from 0.74 to 0.90 across studies), retest reliability (March et al., 1997), and convergent and divergent validity (March et al., 1997; Villabø et al., 2012). Internal consistency in the current sample was α = 0.88 and α = 0.84 for child- and parent-report, respectively.

1.3. Procedures

All study procedures were approved by the Temple University Institutional Review Board. Parents provided written informed consent and youth provided assent. To determine eligibility for treatment, youth and their parents each completed an initial assessment with diagnosticians, following a brief telephone screen. The youth and parents separately completed the diagnostic interview with reliable diagnosticians, and the youth's diagnoses and severity were determined based on a composite of the two interviews. Diagnosticians completed the CGAS, indicated the three top anxiety-provoking situations for the youth and their parents to rate coping efficacy for on the CQ-C/P, and other general measures of psychological functioning. The children and adolescents completed questionnaires about themselves and their anxiety (the CQ-C, IUS-C and MASC-C), pre- and post-treatment. Parents completed parent-report versions of the same questionnaires (the CQ-P, IUS-P, and MASC-P).

Youth who were eligible received CBT (i.e. *Coping Cat* (Kendall & Hedtke, 2006a, 2006b) for children or *C.A.T. Project* (Kendall et al., 2002a, 2002b) for adolescents), with some youth receiving a slightly modified version that specifically targeted parental accommodation. This slightly modified version has not been found to significantly differ on outcome measures. The *Coping Cat* and *C.A.T. Project* are manualized treatment protocols for anxiety disorders in childhood and adolescence. The first half of treatment is focused on psychoeducation and skill building, including cognitive restructuring, relaxation and problem solving when faced with anxiety-provoking situations. The second half treatment involves gradual exposures to anxiety provoking stimuli. Parent participation is encouraged and integrated into the treatment protocol to encourage continued work outside of the clinic. All study therapists were advanced doctoral students who attended weekly group supervision with a licensed clinical psychologist with expertise in CBT for anxiety. Prior to beginning treatment implementation, therapists were trained on the *Coping Cat/C.A.T. Project* protocols to ensure competence and fidelity. Following a course of CBT, the youth and their parents again completed the diagnostic evaluation: diagnosticians determined a composite post-treatment CGAS score and youth and their parents completed questionnaires (the CQ-C/P, the IUS-C/P and the MASC-C/P).

1.4. Data analytic plan

Hierarchical linear regressions (Cohen et al., 2013) tested the hypotheses that a greater reduction in IU from pre- to post-treatment would predict (a) a decrease in functional impairment, (b) an increase in coping efficacy and (c) a decrease in anxiety symptom severity beyond the influences of age, gender, and pre-treatment levels of IU, coping efficacy, functional impairment and anxiety severity. In the first model the dependent variable was the change in CGAS scores (model 1), in the second model the dependent variable was the change in CQ-C/P scores (model 2), and in the third model the dependent variable was the change in MASC-C/P total scores (model 3). Change scores were the difference from pre- to post-treatment. The predictor variable of interest in all three models was the change in IUS-C/P. Given the age of the current sample and previous studies highlighting informant differences in IU assessment validity (Comer et al., 2009), separate models were run using child- and parent-reported measures of the same constructs (detailed below). All data management and analyses were conducted in IBM Statistical Package for the Social Sciences (SPSS), Version 25.

2. Results

2.1. Missing data

Originally, there were 73 youth who had completed pre- and post-treatment assessments. Youth with more than 33% missing data on a measure needed for a given analysis were not included in that specific analysis. Youth who had some missing data but less than 33% on a measure were still included; for these youth, total scores for each of these measures were calculated by using the average of the questions

Table 1
Means, Standard Deviations, Ranges and Correlations Among Study Variables.

	Gender	Age	Pre IUS-C	Pre IUS-P	Pre CQ-C	Pre CQ-P	Pre MASC-C	Pre MASC-P	Pre CGAS	IUS-C Δ	IUS-P Δ	CGAS Δ	CQ-C Δ	CQ-P Δ	MASC-C Δ	MASC-P Δ
M	***44.4% female***	11.56	82.94	83.02	11.60	9.08	51.93	53.71	55.67	−14.53	−11.27	11.00	3.22	5.59	−17.42	−15.93
(SD)	–	2.89	24.85	28.20	3.89	3.58	17.70	14.76	6.16	26.46	23.31	11.52	4.87	4.21	19.99	15.73
Range	–	7.41-17.61	34-147	34-135	3-21	3-19	9-95	23-86	43-70	−77-62	−64.45-40	−14-43	−7-15	−5-14	−60-36	−52.66-24
Gender	1.00															
Age	0.26*	1.00														
Pre IUS-C	0.05	−0.04	1.00													
Pre IUS-P	−0.06	−0.10	0.26*	1.00												
Pre CQ-C	−0.01	−0.09	−0.17	−0.16	1.00											
Pre CQ-P	0.02	−0.17	0.08	−0.27*	0.31*	1.00										
Pre MASC-C	−0.06	0.04	0.57*	0.12	−0.24*	0.16	1.00									
Pre MASC-P	−0.11	0.03	0.30*	0.45*	−0.20	−0.18	0.27*	1.00								
Pre CGAS	−0.05	−0.27*	−0.32*	−0.01	−0.04	0.00	−0.26*	−0.01	1.00							
IUS-C Δ	−0.15	−0.05	−0.39*	0.06	−0.04	−0.25*	−0.07	−0.08	0.28*	1.00						
IUS-P Δ	0.07	0.02	0.12	−0.41*	0.07	−0.11	0.26*	−0.02	0.02	0.06	1.00					
CGAS Δ	0.05	−0.01	0.21	−0.26*	0.21	0.25*	0.01	−0.13	−0.28*	−0.48*	−0.12	1.00				
CQ-C Δ	−0.12	−0.05	0.09	−0.01	−0.52*	−0.10	0.14	0.07	0.08	−0.26*	0.03	0.18	1.00			
CQ-P Δ	−0.09	0.17	−0.17	0.14	−0.27*	-.51*	−0.08	0.12	−0.02	0.11	−0.23	0.05	0.19	1.00		
MASC-C Δ	0.17	0.04	−0.18	0.09	0.14	−0.29*	−0.41*	−0.20	0.07	0.50*	0.01	−0.38*	−0.53*	−0.11	1.00	
MASC-P Δ	−0.04	−0.09	−0.03	0.10	0.04	−0.10	0.11	−0.20	−0.02	0.18	0.36*	−0.35*	−0.01	−0.36*	0.23	1.00

Note: * $p < 0.05$. Δ = Change. Pre IUS-C = Pre-treatment Intolerance of Uncertainty Scale, Child Report. Pre IUS-P = Pre-treatment Intolerance of Uncertainty Scale, Parent Report. Pre CQ-C = Total Score for Pre-treatment Coping Questionnaire – Child Version. Pre CQ-P = Total Score for Pre-treatment Coping Questionnaire – Parent Version. Pre MASC-C = Pre-treatment Multidimensional Anxiety Scale for Children, Child Report, Total Score. Pre MASC-P = Pre-treatment Multidimensional Anxiety Scale for Children, Parent Report, Total Score. Pre CGAS = Pre-treatment Children's Global Assessment Scale Composite Score. IUS-C Change = Change from pre- to post-treatment on the Intolerance of Uncertainty Scale for Children, Child Report. IUS-P Change = Change from pre- to post-treatment on the Intolerance of Uncertainty Scale for Children, Parent Report. CGAS Change = Change from pre- to post-treatment on the Children's Global Assessment Scale. CQ-C Change = Change from pre- to post-treatment on the Coping Questionnaire – Child Version. CQ-P Change = Change from pre- to post-treatment on the Coping Questionnaire – Parent Version. MASC-C Change = Change from pre- to post-treatment on the Multidimensional Anxiety Scale for Children, Child Report, Total Score. MASC-P Change = Change from pre- to post-treatment on the Multidimensional Anxiety Scale for Children, Parent Report, Total Score.

they had answered. Power analyses using an alpha level of 0.05 and an expected effect size of 0.15 indicated that a sample size of 55 provides adequate power (greater than 0.80) to examine study hypotheses, and thus the current study's sample size is sufficiently powered for present analyses.

2.2. Treatment-related change

Table 1 shows the means, standard deviations and ranges for gender, age, Pre IUS-C/P, Pre CGAS, Pre CQ-C/P, Pre MASC-C/P, IUS-C/P Change, CGAS Change, CQ-C/P Change and MASC-C/P Change scores, as well as the correlations among these variables. Scores significantly increased from pre- to post-treatment on the CGAS (mean change = 11.00, SD = 11.52, $t(70) = 8.05$, $p < 0.001$, d = 0.95), indicating a significant treatment-related decrease in youth functional impairment. The CQ-C scores (mean change = 3.22, SD = 4.87, $t(67) = 5.46$, $p < 0.001$, d = 0.66) and CQ-P scores (mean change = 5.59, SD = 4.21, $t(63) = 10.63$, $p < 0.001$, d = 1.33) also significantly increased from pre- to post-treatment, indicating a significant increase in youth's coping ability across informants. Scores significantly decreased from pre- to post-treatment on the IUS-C (mean change = -14.53, SD = 26.46, $t(68) = -4.56$, $p < 0.001$, d = 0.55) and IUS-P (mean change = -11.27, SD = 23.31, $t(64) = -3.90$, $p < 0.001$, d = 0.48), indicating that IU decreased over the course of treatment per child- and parent-report (i.e. tolerance of the uncertain increased). Finally, there was a significant decrease in MASC-C (mean change = -17.42, SD = 19.99, $t(68) = -7.24$, $p < 0.001$, d = 0.87) and MASC-P scores (mean change = -15.93, SD = 15.73, $t(63) = -8.10$, $p < 0.001$, d = 1.01).

2.3. Hierarchical regressions

In the first model, we examined the influences of age, gender, pre-treatment functional impairment, pre-treatment IU, pre-treatment coping efficacy, pre-treatment anxiety severity and change in IU from pre- to post-treatment on change in functional impairment from pre- to post-treatment using a hierarchical multiple regression (model 1). We then examined the same variables' prediction of change in coping efficacy (model 2) and anxiety severity (model 3) from pre- to post-treatment. In the first step of each model, we included age and gender. In the second step, we included pre-treatment functional impairment (CGAS), anxiety severity (MASC-C/P Total Score), IU (IUS-C/P) and coping efficacy (CQ-C/P) to control for baseline differences in variables of interest. In the third step, we included change in IU from pre- to post-treatment. In order to account for informant differences, separate models were run using child- and parent-reported measures of pre-treatment functional impairment, pre-treatment IU, pre-treatment coping efficacy, pre-treatment anxiety severity and change in IU from pre- to post-treatment on change in functional impairment, coping efficacy and anxiety severity from pre- to post-treatment.

2.3.1. Predicting change in functional impairment

Tables 2 and 3 show the results of the hierarchical multiple regressions predicting change in functional impairment from pre- to post-treatment across child- and parent-report, respectively. The first step of model 1 did not account for a significant amount of the variance in change in CGAS scores per child- or parent-report. Neither youth's age nor gender was associated with change in CGAS scores across informants.

In the second step, we added the pre-treatment CQ-C/P, IUS-C/P, MASC-C/P and CGAS scores predicting change in CGAS scores beyond the influence of age and gender. The inclusion of these terms significantly increased the percentage of variance accounted for in change in CGAS scores per child- and parent-report. In this step of model 1 per child-report, age and gender still were not significant predictors of change in CGAS scores, nor were pre-treatment CQ-C/P, IUS-C/P, MASC-C/P or CGAS scores. However, in this step of the parent-reported measures model, pre-treatment CGAS score was a significant predictor of CGAS change, t = -2.09, p = 0.04.

Table 2
Hierarchical Multiple Regression of Change in Youth's Functional Impairment from Pre- to Post-Treatment – Child Report (Children's Global Assessment Scale).

		b	SE	*t*	*β*
Step One	Age	−0.10	0.50	−0.20	−0.03
	Gender	2.45	2.95	0.83	0.12
	Model i	$F(2,64) = 0.35$	$p = 0.71$		
		$R^2 = 0.01$			
Step Two	Age	−0.19	0.51	−0.38	−0.05
	Gender	1.58	2.82	0.56	0.07
	Pre CQ-C	0.56	0.37	1.53	0.19
	Pre IUS-C	0.13	0.07	1.88	0.28
	Pre MASC-C	−0.14	0.10	−1.37	−0.20
	Pre CGAS	−0.43	0.26	−1.68	−0.22
	Model ii	$F(6,60) = 1.98$	$p = 0.08$	$\Delta F(4,60) = 2.77$	$p = 0.04$
		$R^2 = 0.17$		$\Delta R^2 = 0.15$	
Step Three	Age	−0.20	0.47	−0.42	−0.05
	Gender	0.47	2.64	0.18	0.02
	Pre CQ-C	0.47	0.34	1.43	0.16
	Pre IUS-C	0.04	0.07	0.59	0.09
	Pre MASC-C	−0.08	0.09	−0.85	−0.12
	Pre CGAS	−0.29	0.24	−1.23	−0.16
	IUS-C Change	−0.18**	0.05	−3.27	−0.41
	Model iii	$F(7,59) = 3.49$	$p < 0.01$	$\Delta F(1,59) = 10.68$	$p = 0.002$
		$R^2 = 0.29$		$\Delta R^2 = 0.13$	

Note: Pre IUS-C = Pre-treatment Intolerance of Uncertainty Scale for Children. Pre CQ-C = Pre-treatment Coping Questionnaire – Child Version. Pre CGAS = Pre-treatment Children's Global Assessment Scale Composite Score. Pre MASC-C = Pre-treatment Multidimensional Anxiety Scale for Children – Child Version, Total Score. IUS-C Change = Change from pre- to post-treatment on the Intolerance of Uncertainty Scale for Children.
** $p \leq 0.01$.

In the third step, we added the change in IUS-C/P scores from pre- to post-treatment. The change in IUS-C/P scores significantly increased the percentage of variance accounted for in change in CGAS scores in the child- and parent-report models. In this step of the model, the only significant predictor was change in IUS-C/P both per child- and parent-report. The child-report model accounted for 29.0% of the variance in change in CGAS scores, while the parent-report model accounted for 26% of the variance.

2.3.2. Predicting change in coping efficacy

Tables 4 and 5 show the results of the hierarchical multiple regressions for the models predicting change in coping efficacy from pre- to post-treatment across child- and parent-report, respectively. The first step of model 2 did not account for a significant amount of the variance in change in CQ-C/P scores per child- or parent-report. Across informants, youth's age and gender were not associated with change in CQ-C/P scores.

In the second step, we added the pre-treatment CQ-C/P, IUS-C/P, MASC-C/P and CGAS scores predicting change in CQ-C/P scores, beyond the influence of age and gender. The inclusion of these terms significantly increased the percentage of variance accounted for in change in CQ-C/P scores per child- and parent-report. In this step, pre-treatment CQ-C/P scores significantly predicted change in CQ-C/P scores per child- and parent-report, but age, gender, pre-treatment IUS-C/P scores, pre-treatment MASC-C/P, and pre-treatment CGAS scores did not. This model accounted for 27% of the variance in change in CQ-

Table 3
Hierarchical Multiple Regression of Change in Youth's Functional Impairment from Pre- to Post-Treatment – Parent Report (Children's Global Assessment Scale).

		b	SE	*t*	*β*
Step One	Age	−0.08	0.52	−0.15	−0.02
	Gender	2.92	3.09	0.95	0.13
	Model i	$F(2,58) = 0.45$ $R^2 = 0.02$	$p = 0.64$		
Step Two	Age	−0.38	0.53	−0.71	−0.10
	Gender	2.30	2.91	0.79	0.10
	Pre CQ-P	0.66	0.40	1.66	0.21
	Pre IUS-P	−0.08	0.06	−1.44	−0.21
	Pre MASC-P	−0.01	0.11	−0.13	−0.02
	Pre CGAS	−0.50*	0.24	−2.09	−0.27
	Model ii	$F(6,54) = 2.35$ $R^2 = 0.21$	$p = 0.04$	$\Delta F(4,54) = 3.26$ $\Delta R^2 = 0.19$	$p = 0.02$
Step Three	Age	−0.52	0.52	−0.99	−0.13
	Gender	2.93	2.84	1.03	0.13
	Pre CQ-P	0.46	0.40	1.15	0.15
	Pre IUS-P	−0.14*	0.06	−2.27	−0.36
	Pre MASC-P	0.03	0.11	0.24	0.03
	Pre CGAS	−0.51*	0.23	−2.21	−0.28
	IUS-P Change	−0.13*	0.07	−2.03	−0.28
	Model iii	$F(7,53) = 2.72$ $R^2 = 0.26$	$p = 0.02$	$\Delta F(1,53) = 4.13$ $\Delta R^2 = 0.06$	$p = 0.05$

Note: Pre IUS-P = Pre-treatment Intolerance of Uncertainty Scale for Children, Parent Report. Pre CQ-P = Pre-treatment Coping Questionnaire – Parent Version. Pre CGAS = Pre-treatment Children's Global Assessment Scale Composite Score. Pre MASC-P = Pre-treatment Multidimensional Anxiety Scale for Children – Parent Version, Total Score. IUS-P Change = Change from pre- to post-treatment on the Intolerance of Uncertainty Scale for Children, Parent Report.
* $p < 0.05$.

C scores and 27% of the variance in change in CQ-P scores.

In the third step, we added the change in IUS-C/P scores from pre- to post-treatment predicting change in CQ-C/P scores, beyond the influence of the variables in the first two steps. The change in IUS-C/P scores significantly increased the percentage of variance accounted for in change in CQ-C scores and CQ-P scores. In this step, change in coping efficacy was significantly predicted by pre-treatment CQ-C/P scores and change in IUS-C/P scores across informants. This final child-reported model accounted for 40% of the variance in change in CQ-C scores, while the final parent-reported model accounted for 37% of the variance.

2.3.3. Predicting change in anxiety severity

Tables 6 and 7 show the results of the hierarchical multiple regressions for the models predicting change in anxiety severity from pre- to post-treatment across child- and parent-report, respectively. The first step of model 2 did not account for a significant amount of the variance in change in anxiety severity scores per child- or parent-report.

In the second step, we added the pre-treatment CQ-C/P, IUS-C/P, MASC-C/P and CGAS scores predicting change in MASC-C/P scores, beyond the influence of age and gender. The inclusion of these terms did not significantly increased the percentage of variance accounted for in change in anxiety severity for parent-report, but did account for significant change per child-report. In this step, change in anxiety severity was significantly predicted by pre-treatment MASC-C.

In the third step, we added the change in IUS-C/P scores from pre- to post-treatment predicting change in MASC-C/P scores, beyond the influence of the variables in the first two steps. The change in IUS-C/P scores significantly increased the percentage of variance accounted for in change in MASC-C scores and MASC-P scores. In this step of the child-report model, change in anxiety severity was significantly predicted by gender, pre-treatment IUS-C, pre-treatment MASC-C, and IUS-C change. In this step of the parent-report model, change in anxiety

Table 4
Hierarchical Multiple Regression of Change in Youth's Coping Efficacy from Pre- to Post-Treatment – Child Report (Change on the Coping Questionnaire – Child Version).

		b	SE	*t*	*β*
Step One	Age	0.01	0.21	0.06	0.01
	Gender	−0.88	1.24	−0.71	−0.09
	Model i	$F(2,62) = 0.26$ $R^2 = 0.01$	$p = 0.78$		
Step Two	Age	−0.03	0.20	−0.15	−0.02
	Gender	−0.83	1.11	−0.75	−0.09
	Pre CQ-C	−0.64***	0.15	−4.38	−0.52
	Pre IUS-C	0.00	0.03	0.16	0.02
	Pre MASC-C	−0.01	0.04	−0.31	−0.04
	Pre CGAS	0.04	0.10	0.43	0.06
	Model ii	$F(6,58) = 3.60$ $R^2 = 0.27$	$p = 0.004$	$\Delta F(4,58) = 5.24$ $\Delta R^2 = 0.26$	$p = 0.001$
Step Three	Age	−0.03	0.18	−0.15	−0.02
	Gender	−1.24	1.02	−1.21	−0.13
	Pre CQ-C	−0.69***	0.14	−5.09	−0.56
	Pre IUS-C	−0.03	0.03	−1.19	−0.17
	Pre MASC-C	0.01	0.04	0.30	0.04
	Pre CGAS	0.10	0.09	1.08	0.13
	IUS-C Change	−0.07***	0.02	−3.47	−0.41
	Model iii	$F(7,57) = 5.39$ $R^2 = 0.40$	$p < 0.001$	$\Delta F(1,57) = 12.02$ $\Delta R^2 = 0.13$	$p = 0.001$

Note: Pre IUS-C = Pre-treatment Intolerance of Uncertainty Scale for Children. Pre CQ-C = Pre-treatment Coping Questionnaire – Child Version. Pre CGAS = Pre-treatment Children's Global Assessment Scale Composite Score. Pre MASC-C = Pre-treatment Multidimensional Anxiety Scale for Children – Child Version, Total Score. IUS-C Change = Change from pre- to post-treatment on the Intolerance of Uncertainty Scale for Children.
*** $p \leq 0.001$.

severity was significantly predicted by pre-treatment IUS-P, pre-treatment MASC-P, and IUS-P change. The final child-reported model accounted for 48% of the variance in change in MASC-C scores, while the final parent-reported model accounted for 33% of the variance.

3. Discussion

Although IU is an important cognitive variable implicated in anxiety, the role that IU plays in the maintenance and treatment of youth anxiety requires further exploration. In line with hypotheses, results of the current study indicate that decreases in IU throughout treatment were significantly associated with decreases in symptom severity (MASC-C/P) and concurrent functional impairment (CGAS), along with increases in coping efficacy (CQ-C/P). Findings held after taking into account age, gender and pre-treatment differences in IU and outcome measures (anxiety severity, functional impairment, difficulty coping with anxiety), and were also consistent across child- and parent-report. Study results suggest the possibility that a greater focus on IU in therapy may enhance the efficacy of CBT. Results also highlight changes in IU as a candidate mechanism of action for examination in future studies.

Pre-treatment functional impairment did not predict treatment outcomes as measured by coping efficacy or symptom severity. This result diverges somewhat from earlier findings showing that greater impairment predicts less favorable outcomes (Compton et al., 2014). However, this study used different outcome measures (the Pediatric Anxiety Ratings Scale and the Clinical Global Impression Improvement Scale), which may account for the difference. Consistent with findings in the adult literature (Boswell et al., 2013; Mahoney & McEvoy, 2012), the present findings demonstrate that reductions in IU following a

Table 5
Hierarchical Multiple Regression of Change in Youth's Coping Efficacy from Pre- to Post-Treatment – Parent Report (Change on the Coping Questionnaire – Parent Version).

		b	SE	*t*	*β*
Step One	Age	0.32	0.19	1.66	0.23
	Gender	−1.09	1.15	−0.95	−0.13
	Model i	$F(2,56) = 1.51$ $R^2 = 0.05$	$p = 0.23$		
Step Two	Age	0.19	0.19	0.98	0.14
	Gender	−0.53	1.06	−0.50	−0.06
	Pre CQ-P	−0.58***	0.16	−3.66	−0.48
	Pre IUS-P	0.01	0.02	0.34	0.05
	Pre MASC-P	−0.01	0.04	−0.30	−0.04
	Pre CGAS	0.01	0.09	0.11	0.01
	Model ii	$F(6,52) = 3.21$ $R^2 = 0.27$	$p = 0.009$	$\Delta F(4,52) = 3.90$ $\Delta R^2 = 0.22$	$p = 0.008$
Step Three	Age	0.13	0.18	0.69	0.09
	Gender	−0.27	1.00	−0.27	−0.03
	Pre CQ-P	−0.68***	0.15	−4.44	−0.56
	Pre IUS-P	−0.02	0.02	−0.97	−0.15
	Pre MASC-P	0.01	0.04	0.15	0.02
	Pre CGAS	0.01	0.08	0.07	0.01
	IUS-P Change	−0.06**	0.02	−2.80	−0.36
	Model iii	$F(7,51) = 4.23$ $R^2 = 0.37$	$p = 0.001$	$\Delta F(1,51) = 7.83$ $\Delta R^2 = 0.10$	$p = 0.007$

Note: Pre IUS-P = Pre-treatment Intolerance of Uncertainty Scale for Children, Parent Report. Pre CQ-P = Pre-treatment Coping Questionnaire – Parent Version. Pre CGAS = Pre-treatment Children's Global Assessment Scale Composite Score. Pre MASC-P = Pre-treatment Multidimensional Anxiety Scale for Children – Parent Version, Total Score. IUS-P Change = Change from pre- to post-treatment on the Intolerance of Uncertainty Scale for Children, Parent Report.

** $p \leq 0.01$.

*** $p \leq 0.001$.

Table 6
Hierarchical Multiple Regression of Change in Youth Anxiety Severity from Pre- to Post-Treatment – Child Report (Change on the Multidimensional Anxiety Scale for Children, Child Version).

		b	SE	*t*	*β*
Step One	Age	−0.01	0.85	−0.01	−0.00
	Gender	5.52	5.04	1.10	0.14
	Model i	$F(2,64) = 0.64$ $R^2 = 0.02$	$p = 0.53$		
Step Two	Age	0.16	0.87	0.19	0.02
	Gender	5.29	4.83	1.09	0.14
	Pre CQ-C	0.23	0.63	0.36	0.05
	Pre IUS-C	0.02	0.12	0.18	0.03
	Pre MASC-C	−0.44*	0.17	−2.57	−0.38
	Pre CGAS	−0.00	0.44	−0.00	−0.00
	Model ii	$F(6,60) = 1.94$ $R^2 = 0.16$	$p = 0.09$	$\Delta F(4,60) = 2.55$ $\Delta R^2 = 0.14$	$p = 0.05$
Step Three	Age	0.18	0.69	0.27	0.03
	Gender	7.74*	3.86	2.01	0.20
	Pre CQ-C	0.50	0.50	0.99	0.10
	Pre IUS-C	0.26*	0.10	2.58	0.33
	Pre MASC-C	−0.58***	0.14	−4.15	−0.49
	Pre CGAS	−0.36	0.35	−1.03	−0.11
	IUS-C Change	0.48***	0.08	6.02	0.65
	Model iii	$F(7,59) = 7.81$ $R^2 = 0.48$	$p < 0.001$	$\Delta F(1,59) = 36.24$ $\Delta R^2 = 0.32$	$p < 0.001$

Note: Pre IUS-C = Pre-treatment Intolerance of Uncertainty Scale for Children. Pre CQ-C = Pre-treatment Coping Questionnaire – Child Version. Pre CGAS = Pre-treatment Children's Global Assessment Scale Composite Score. Pre MASC-C = Pre-treatment Multidimensional Anxiety Scale for Children – Child Version, Total Score. IUS-C Change = Change from pre- to post-treatment on the Intolerance of Uncertainty Scale for Children.

* $p \leq 0.05$.

*** $p \leq 0.001$.

course of CBT are related to reductions in youth functional impairment and anxiety severity, along with increased coping efficacy. One possible explanation may point to the relationship between IU and worry, with worry being seen as the central cognitive component of anxiety (Barlow, 2002; Fialko et al., 2012; Vasey & Daleiden, 1994). Some research suggests that youth often worry to achieve certainty, resulting in the generation of more evidence that he or she cannot handle uncertainty, which in turn makes them more anxious and the experience of uncertainty more aversive (Dugas et al., 2012). Decreases in worry over the course of CBT for youth anxiety could mediate the relationship between IU and treatment outcomes or vice versa. Changes in coping efficacy may also potentially mediate the relationship between IU and symptom severity, or decreases in IU may mediate the relationship between coping efficacy, symptom severity and functional impairment. These empirical questions merit investigation.

The relationship between decreased IU and decreased anxiety severity following treatment may also be related to the role IU plays in youth's cognitions. The findings in this study are in line with previous studies emphasizing the role that addressing IU in treatment has on reducing negative thinking towards uncertainty (Carleton, 2016a, 2016b; Shihata et al., 2016); explicit and implicit exposures to uncertainty in treatment may lead to a reduction in overall IU. The structure of the *Coping Cat* (Kendall & Hedtke, 2006a, 2006b) and *C.A.T. Project* (Kendall et al., 2002a, 2002b) protocols provides several opportunities to address maladaptive thinking via cognitive restructuring. Given that increased IU is associated with negative interpretation of ambiguity and uncertainty (Carleton, 2016b), challenging these negative interpretations during the early stages of treatment may simultaneously work as both cognitive restructuring as well as in vivo exposures to the uncertainty. IU may also have been reduced because of the opportunity to experience uncertainty in various contexts through exposures (Carleton, 2016a), allowing youth to learn new associations between uncertainty and outcomes. Overall, this raises the possibility that the *Coping Cat* and *C.A.T. Project* may be effective, transdiagnostic, indirect treatments of IU in youth.

Further research is needed to evaluate the direction of the relationship between IU, coping efficacy, functional impairment and symptom severity in order to determine the potential benefit of targeting IU directly when working with treatment-resistant youth. For instance, it may be that some CBT recipients actually increase their ability to implement skills that will reduce uncertainty (e.g. by performing cognitive restructuring surrounding a feared outcome before completing an exposure and thus decreasing the level of uncertainty associated with the experience) rather than increase their ability to tolerate uncertainty. While there are several theories that analyze the role that learning plays in the development of IU (e.g., attentional inhibition, neurological and physiological mechanisms, threat and fear extinction, see Grupe & Nitschke, 2013; Morriss, Christakou, et al., 2016; Morriss, Macdonald, et al., 2016; Morriss et al., 2016; Morriss & McSorley, 2019), an inhibitory learning approach (Craske et al., 2014) may be particularly relevant for youth high in IU who do not respond to traditional CBT because this approach encourages an individual to fully experience uncertainty when engaging in an exposure. A habituation model can also be useful for understanding the relationship between IU, coping, functional impairment and symptom severity, especially as it relates to the exposure component of CBT. The habituation model contends that anxiety reduction will occur through continuous contact with the anxiety-inducing stimulus as long as the individual does not

Table 7
Hierarchical Multiple Regression of Change in Youth Anxiety Severity from Pre- to Post-Treatment – Parent Report (Change on the Multidimensional Anxiety Scale for Children, Parent Version).

		b	SE	*t*	*β*
Step One	Age	−0.73	0.73	−1.00	−0.14
	Gender	0.36	4.36	0.08	0.01
	Model i	$F(2,56) = 0.52$	$p = 0.60$		
		$R^2 = 0.02$			
Step Two	Age	−0.94	0.81	−1.17	−0.18
	Gender	−0.38	4.41	−0.09	−0.01
	Pre CQ-P	−0.60	0.60	−1.00	−0.14
	Pre IUS-P	0.10	0.09	1.10	0.17
	Pre MASC-P	−0.30	0.16	−1.85	−0.28
	Pre CGAS	−0.35	0.37	−0.94	−0.13
	Model ii	$F(6,52) = 0.99$	$p = 0.44$	$\Delta F(4,52) = 1.23$	$p = 0.31$
		$R^2 = 0.10$		$\Delta R^2 = 0.09$	
Step Three	Age	−0.56	0.71	−0.79	−0.11
	Gender	−2.10	3.88	−0.54	−0.07
	Pre CQ-P	−0.06	0.54	−0.11	−0.01
	Pre IUS-P	0.26**	0.09	3.04	0.46
	Pre MASC-P	−0.41**	0.14	−2.84	−0.38
	Pre CGAS	−0.30	0.32	−0.94	−0.12
	IUS-P Change	0.36***	0.09	4.13	0.54
	Model iii	$F(7,51) = 3.55$	$p = 0.003$	$\Delta F(1,51) = 17.07$	$p < 0.001$
		$R^2 = 0.33$		$\Delta R^2 = 0.23$	

Note: Pre IUS-P = Pre-treatment Intolerance of Uncertainty Scale for Children, Parent Report. Pre CQ-P = Pre-treatment Coping Questionnaire – Parent Version. Pre CGAS = Pre-treatment Children's Global Assessment Scale Composite Score. Pre MASC-P = Pre-treatment Multidimensional Anxiety Scale for Children – Parent Version, Total Score. IUS-P Change = Change from pre- to post-treatment on the Intolerance of Uncertainty Scale for Children, Parent Report.

** $p \leq 0.01$.

*** $p \leq 0.001$.

engage in active attempts to reduce anxiety (i.e., avoidance). From a habituation perspective, treatments that emphasize coping behaviors could be attempts to reduce anxiety and would thusly hinder the habituation process (Benito & Walther, 2015). Both habituation and inhibitory learning approaches indicate that steps taken to reduce uncertainty during an exposure may interfere with beneficial learning.

Components of therapy that target IU (IU therapy; IUT) for adults (Dugas & Ladouceur, 2000; Hewitt et al., 2009; Ladouceur, Dugas, et al., 2000; van der Heiden et al., 2012) may be informative for improving outcomes in treatment-resistant anxious youth. IUT is designed to help individuals develop self-efficacy in their ability to tolerate and accept uncertainty. A key component of the intervention involves asking individuals to re-evaluate and challenge worry beliefs and negative cognitions via behavioral experiments (e.g., worry about one of your pets more than the other and observe the effects on their well-being, or order a new drink at a coffee shop to test negative thoughts about uncertainty; Hebert & Dugas, 2019; van der Heiden et al., 2012). Individuals are instructed to record and repeatedly listen to descriptions of frightening images surrounding situations that are not easily solved. Through repeated exposure, the ability to tolerate the uncertainty increases, which may make the situation less threatening. IUT aligns with inhibitory learning and habituation, and holds that attempts to reduce anxiety during exposure may interfere with learning. Further work is needed to examine whether employing core principles from IUT can improve outcomes for treatment-resistant anxious youth. Further studies should also compare IUT with other evidence based treatments for anxiety that address IU to determine if one approach may be more beneficial to youth with higher levels of IU. This may be particularly informative work as the question remains if IU's importance lies solely in its role in fear learning or if IU holds its own, distinct importance (Brosschot et al., 2016).

Strengths of the present study include the use of an empirically supported treatment in an outpatient anxiety clinic with diagnosed cases with few exclusionary criteria. Additionally, the functional importance of the outcomes to the specific individuals studied is buttressed by the use of an outcome measure that is individualized to each youth (i.e. the CQ-C/P). Study limitations merit mention. The analyses included youth who were primarily Caucasian; future research should include a more diverse sample. Second, causality cannot be established because changes in IU were not manipulated. As a result, treatment-related gains may have caused the observed IU changes, rather than the reverse. It also cannot be ruled out that reduced IU was a treatment-related gain and thus study results are simply due to treatment-related change correlating with itself. Further studies are needed using an experimental design to better address questions of causality and the temporal relationship between constructs examined in the current study. Additionally, the measure of IU used for the present analyses was chosen because it captures how aversive a youth finds uncertainty. However, although this measure has strong psychometric properties, it has not been as extensively researched as another established measure of IU in children (i.e. Comer et al.'s 2009 Intolerance of Uncertainty Scale for Children). Finally, although self- and parent-report of IU is appropriate, the eventual development and inclusion of an objective measure would be a welcome addition. Given the known flaws of self-report and parent-report measures, objective measures can incorporate behavioral observation and specific indicators of IU (e.g., presence of physiological symptoms when presented with uncertainty) marked by an observer. An objective measure may be better suited to inform treatment recommendations for addressing IU within the context of anxiety disorders in youth.

The current findings highlight the importance of IU in CBT treatments for youth anxiety. Results suggest that increased ability to tolerate uncertainty over a course of CBT predicts improvements across a range of domains (functional impairment, coping efficacy, anxiety severity) and informants (parent and child), above and beyond baseline demographic and symptom profile differences. IU may therefore be an important target for clinical intervention and for future research seeking to enhance youth anxiety treatment efficacy.

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