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Factor structure of the intolerance of uncertainty scale for children

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ABSTRACT

Intolerance of uncertainty (IU), a dispositional negative orientation toward uncertainty and its consequences, has been studied in adults, but research has only recently examined IU in youth. Despite some advances, little is known about the factor structure of measures of IU in youth. The present study used confirmatory factor analysis to examine the structure of IU as measured by the Intolerance of Uncertainty Scale for Children (IUSC; Comer et al., 2009) in a sample of youth (N = 368) 9–18 years of age (M_{age} = 12.47) with and without anxiety disorders and their mothers. Findings demonstrated multiple acceptable factor structures: a correlated factors 2-factor structure and a bifactor model where a general factor underlies all items. While the bifactor model provides better fit and reliability to the data, multivariate analyses indicated that the 2-factor structure distinguishes apprehensive anxiety regarding future events (prospective IU) from present-focused inhibition of behavior due to uncertainty and negative reactions to the presence of uncertainty (inhibitory IU); a total IU score predicted all anxiety domains for self- and parent-reports except for parent-report harm avoidance. Findings are discussed in terms of consistency of IU across adult and youth samples, and how results can inform treatment efforts and etiologic models of IU and anxiety.

1. Introduction

Intolerance of uncertainty (IU) refers to a dispositional negative orientation toward uncertainty and its consequences, and is associated with a tendency to react negatively on emotional, cognitive, and behavioral levels to uncertain and unpredictable situations (Buhr & Dugas, 2002; Dugas, Schwartz, & Francis, 2004). In adults, IU is relatively stable, is associated with a broad range of anxiety and mood problems (Carleton et al., 2012; Carleton, Sharpe, & Asmundson, 2007; Gentes & Ruscio, 2011; Holaway, Heimberg, & Coles, 2006; Yook, Kim, Suh, & Lee, 2010), and has been proposed as a transdiagnostic factor in the development and treatment of emotional disorders (Boswell, Thompson-Hollands, Farchione, & Barlow, 2013; Carleton, 2016; McEvoy & Erceg-Hurn, 2016).

Recent systematic reviews of the IU literature have highlighted the need to more comprehensively study the assessment of IU in children and the association between IU and various forms of psychopathology (e.g., Shihata, McEvoy, Mullan, & Carleton, 2016). Although the majority of research on IU has been conducted in adult samples, recent years have witnessed considerable advances in the identification, measurement, and understanding of IU in youth samples (i.e. individuals under the age of 19) (Comer et al., 2009; Read, Comer, & Kendall, 2013; Sanchez et al., 2017). Indeed, we now know that IU can be reliably assessed in children and adolescents (Comer et al., 2009), and as with adult IU, child IU is associated with a range of internalizing problems (Boelen, Vrinssen, & van Tulder, 2010; Comer et al., 2009; Dugas, Laugesen, & Bukowski, 2012; Laugesen, Dugas, & Bukowski, 2003; Read et al., 2013; Sanchez et al., 2017). Further, IU aggregates in families, and links between maternal and child IU may mediate the intergenerational transmission of anxiety (Sanchez, Kendall, & Comer, 2016). That is, observed associations between maternal and child anxiety may be explained by the extent to which maternal anxiety predicts maternal IU, which in turn can engender child IU and consequent child anxiety. Despite these advances, however, little is known about the structure of measures of IU in youth.

To date, factor analytic work examining measures of IU has been

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confined predominantly to adult samples. Early exploratory factor analytic work evaluating items on the adult 27-item Intolerance of Uncertainty Scale (IUS; Freeston, Rhéaume, Letarte, Dugas, & Ladouceur, 1994) initially identified a 5-factor (Freeston et al., 1994) structure and a 4-factor structure (Buhr & Dugas, 2002) on the French and English IUS, respectively. Sexton and Dugas (2009) identified an alternative 2-factor structure. This factor solution—which distinguishes "uncertainty has negative behavioral and self-reference implications" and "uncertainty is unfair and spoils everything"—has demonstrated strong support in both exploratory and confirmatory factor analyses utilizing very large samples (Sexton & Dugas, 2009), with the first factor, relative to the second factor, showing stronger associations with generalized anxiety, somatic anxiety, and depression.

Carleton, Norton, and Asmundson (2007) highlight problems of item redundancy and unrelatedness in the initially identified factor solutions, and confirmatory factor analytic work failed to replicate early results across diverse groups of individuals (Norton, 2005). Moreover, problematic item loadings and poor factor interpretability led some to suggest that removing items from the longer 27-item IUS would improve its factor structure (e.g., Norton, 2005).

Research with adults has supported more parsimonious 2-factor IU solutions, often in shortened versions of the IUS. Carleton, Norton et al. (2007) identified a 2-factor IU structure in a 12-item version of the IUS (i.e., IUS-12) that broadly distinguished "prospective" and "inhibitory" IU. *Prospective IU*—referring to apprehensive anxiety, fear regarding future events, and a desire for predictability—is inherently future-oriented and has been linked to worry, generalized anxiety disorder (GAD), and obsessive-compulsive disorder (OCD) (e.g., Hong & Lee, 2015; McEvoy & Mahoney, 2011). In contrast, *Inhibitory IU*—referring to inhibition of behavior due to uncertainty, uncertainty paralysis, and negative reactions in the presence of uncertainty—is more present-focused and has been linked to social anxiety disorder (Carleton, Collimore, & Asmundson, 2010), panic disorder (Carleton, Sharpe et al., 2007), and depression (McEvoy & Mahoney, 2012). Given the favorable psychometric properties of the shortened IUS-12 (Carleton, Norton et al., 2007), the IUS-12 and the prospective/inhibitory 2-factor model have been increasingly incorporated into adult studies examining IU.

Other recent factor analytic work in adult samples has considered whether a general factor of IU might underlie all items of the IUS-12. Hale et al. (2016), using bifactor confirmatory factor analysis, found better support for a model examining a general factor of IU than a model examining the two factors of prospective and inhibitory IU. This work suggests that the IUS-12 for adults may be better scored with a unidimensional total score rather than with separate prospective/inhibitory subscale scores. Specifically, this work found poor model fit in a correlated 2-factor confirmatory factor analysis, which is contrary to other work that has found acceptable model fit in similar models. However, this research, along with much of the other prominent factor analytic research on IU (e.g., Carleton, Norton et al., 2007), examined the IUS in a non-clinical sample of undergraduates. Factor analytic investigations of IU in clinical samples is critical.

Although anxiety disorders tend to first onset in childhood (Comer & Olfson, 2010; Merikangas et al., 2010), and emerging longitudinal work suggests that IU may play an etiologic role in the development of worry and related anxiety symptoms (Dugas et al., 2012), much remains to be learned about the structure of IU measures in youth. Boelen et al. (2010) conducted the only study to use factor analysis to consider the structure of IU in individuals below the age of 19, and found preliminary support for the Carleton, Norton et al. (2007) 2-factor prospective/inhibitory structure of IU in adolescents. However, their study was restricted to adolescents over the age of 14, they only considered the Carleton, Norton et al. (2007) 2-factor prospective/inhibitory model of IU, and they did not consider alternative factor structures that have also been identified in the adult literature. Further, they had youth complete the adult IUS rather than a measure specifically created for children.

The Intolerance of Uncertainty Scale for Children (IUSC; Comer et al., 2009) was developed specifically for youth; IUSC items map directly onto the items of the adult IUS but the language was changed for developmental compatibility. For example, metacognitive content was removed (e.g., "my mind can't be relaxed when…" became "I can't relax when…"), figurative and complex language was removed as were idioms whose meanings children may not easily deduce from literal definitions of the words (e.g., "sleeping soundly" became "sleeping well"), and the number of polysyllabic (i.e., > 3 syllable) words was reduced (e.g., "the ambiguities of life" became "things that are unclear"). The IUSC has shown strong validity and reliability in youth samples (Comer et al., 2009), but its factor structure has yet to be evaluated.

To date, no study has (a) comparatively evaluated multiple potential factor structures of measures of IU in a youth sample, (b) examined the structure of an IU measure in youth below the age of 14, or (c) factor analyzed the structure of IU in children or adolescents using IU items developed specifically for and supported in youth populations. Informed by the factor analytic examinations of IU in adult samples, the present study applied confirmatory factor analysis to examine the structure of IU in a large sample of youth with and without anxiety disorders using the IUSC. After identifying a preferred IUSC factor structure in youth, subsequent analyses examined differential associations between the identified factors and anxiety symptom domains.

2. Method

2.1. Participants

Participants (N = 368) were youth ages 9–18 years (M = 12.47, SD = 2.4) with and without anxiety disorders, and their mothers. Roughly half (49.1%) of participating youth were female, 68.2% identified as non-Hispanic/White, 16.6% identified as Black or African American, 4.3% identified as Hispanic/Latino, 3.0% identified as Asian, 0.3% identified as American Indian or Alaskan Native, and 2.4% identified as other. Participants were recruited for various psychopathology and treatment outcome studies from three metropolitan sites in the Northeast region of the United States: the Temple University Child and Adolescent Anxiety Disorders Clinic (CAADC; n = 155), the Boston University Center for Anxiety and Related Disorders (CARD; n = 132), and the New York University Child Study Center (n = 81). Anxious youth (n = 221) and their mothers were recruited from the flow of families seeking treatment for child anxiety problems at these centers. These anxious youth and their mothers completed study measures on paper as part of a pre-treatment battery of questionnaires. Non-referred community participants (n = 147) were also recruited at these same centers for various psychopathology and treatment outcome studies from similar communities as families seeking anxiety services; these community participants also filled out measures on paper as part of a larger battery of questionnaires for the respective study in which they were recruited to participate.

Of the subsample of anxious participants, youth met criteria for the following DSM-IV disorders as assessed by doctoral or masters-level clinicians using the Anxiety Disorders Interview Schedule for Children (ADIS; Silverman & Albano, 1996): GAD (53.8%), social anxiety disorder (27.6%), specific phobia (18.1%), separation anxiety disorder (10.0%), OCD (9.0%), depressive disorder (including major depressive disorder or dysthymic disorder) (7.7%), anxiety disorder not otherwise specified (1.8%), trichotillomania (1.8%), selective mutism (1.4%), panic disorder without agoraphobia (1.4%), panic disorder with agoraphobia (0.9%), posttraumatic stress disorder (0.9%), and agoraphobia (0.5%).

2.2. Measures

2.2.1. Intolerance of uncertainty

Intolerance of uncertainty was measured using the Intolerance of Uncertainty Scale for Children (IUSC; Comer et al., 2009). The IUSC is a 27-item measure with a self-report form and a parent-report form examining IU on a Likert-style scale from 1 to 5 (1: "Not at all;" 3: "Somewhat;" 5: "Very much"). The IUSC was adapted from the adult version of the measure, the Intolerance of Uncertainty Scale (IUS; Freeston et al., 1994). All items are directly parallel to IUS items, but wordings were changed for child compatibility. The factor structure of a shorter 12-item version of this measure (IUSC-12), modeled after the IUS-12 (Carleton, Norton et al., 2007), is also examined in the present study. Internal consistency was strong in the present sample for both the IUSC ($\alpha = 0.87$ for child-report; $\alpha = 0.97$ for parent-report) and the IUSC-12 ($\alpha = 0.86$ for child-report; $\alpha = 0.94$ for parent-report).

2.2.2. Child anxiety domains

Domains of child anxiety were measured using the Multidimensional Anxiety Scale for Children (MASC; March, Parker, Sullivan, Stallings, & Conners, 1997). The MASC is a 39-item measure with a self-report form and a parent-report form assessing various components of anxiety. MASC subscales are used to assess different presentations of anxiety: physical symptoms (assessing somatic symptoms of anxiety), harm avoidance (assessing worry about/avoidance of negative outcomes), social anxiety, and separation anxiety. The MASC has demonstrated strong psychometric properties across multiple samples (March & Albano, 1998; March, Sullivan, & Parker, 1999), and showed high internal consistency in the present sample ($\alpha = 0.90$ for child-report; $\alpha = 0.91$ for parent-report).

2.3. Analytic strategy

Confirmatory factor analysis (CFA) was used to examine the factor structure of the IUSC using MPlus 7.2, using the weighted least squares (WLSMV) estimator, in the combined sample of anxious and community youth. We examined several leading IU factor structures identified in the adult literature based on the full 27-item measure and the shortened 12-item measure (Carleton, Norton et al., 2007; Sexton & Dugas, 2009). Specifically, in separate analyses for child- and parent-reports, CFA examined a unifactorial solution of the full 27 items on the IUSC, the 2-factor structure of the full 27 items identified by Sexton and Dugas (2009), a unifactorial solution of an abridged 12-item IUSC that is parallel to the adult IUS-12, the 2-factor prospective/inhibitory structure of the abridged 12-item IUSC (supported by Carleton, Norton et al., 2007). Additionally, bifactor models examined whether a general factor explained the variance better than the 2-factor prospective/inhibitory structure. Model fit was evaluated using conventional fit indices and interpreted according to cutoff guidelines (Hu & Bentler, 1999; Yu, 2002): Chi-squared test (χ^2; smaller values indicate better fit), Comparative Fit Index (CFI; values ≥ 0.95 are considered good), Root Mean Square Error of Approximation (RMSEA; values ≤ 0.06 are considered good), and weighted root mean square residual (WRMR; values ≤ 1.0 are considered good). A model was deemed "good" if the CFI, RMSEA and WRMR all fell in the good range. A model was deemed "mixed" if two of the three (CFI, RMSEA, WRMR) indices fell in the good range. A model was deemed "poor" if only one or none of the fit indices fell in the good range. For the bifactor models, various reliability indices were calculated (Dueber, 2016). The omega hierarchical statistic (ω_H) was calculated to determine the amount of variance accounted for by the *general* underlying "intolerance of uncertainty" factor. An omega statistic was also calculated for the individual subscales (ω_S) within the bifactor model to determine the proportion of reliable variance in the subscale composite that is independent of the general factor. The explained common variance (ECV) was also computed for the general factor to identify the proportion of all common variance that is explained by the general factor; higher values indicate a higher proportion of the variance is explained by the general factor (Reise et al., 2010). Finally, a Chi-square difference test (DIFFTEST) was computed (using the DIFFTEST function of MPlus) to determine whether there was a significant difference between the fit of the bifactor model and the fit of the 2-factor correlated factors model.

Follow-up multivariate analyses, within a subset of participants who completed the MASC ($n_{childMASC} = 78$; $n_{motherMASC} = 123$), examined relationships between the IUSC subscales and anxiety symptom domains. Specifically, four multivariate general linear models (two for child-report IUSC data and two for parent-report IUSC data) were run to examine relationships between prospective versus inhibitory IU, and total IU, with anxiety symptom domains as reported via the MASC. In the prospective/inhibitory models, prospective and inhibitory IU were entered simultaneously as predictors and MASC symptom domains were entered simultaneously as dependent variables. In separate models, the total IU score was entered as a predictor and MASC symptom domains were entered simultaneously as dependent variables. To account for multiple comparisons within each multivariate model, Bonferroni-adjusted alpha levels were applied; specifically, given the four dependent variables, all p values were compared against a 0.01 (0.05/4) criterion.

3. Results

3.1. Factor structure

Table 1 presents model fit statistics for child self-report IUSC data and parent-report IUSC data for the overall sample. First, a 1-factor structure and a 2-factor structure (identified in adults by

Table 1
Confirmatory factor analysis fit indices for child- and parent-report IUSC data.

Items (Factors)	Total Sample									
	Child-Report (n = 354)					Parent-Report (n = 353)				
	χ^2	CFI	RMSEA	WRMR	Fit Category	χ^2	CFI	RMSEA	WRMR	Fit Category
27(1)	674.65	0.96	0.06	1.06	Mixed	1449.26	0.95	0.10	1.60	Poor
27(2)[a]	670.92	0.96	0.06	1.06	Mixed	1107.29	0.96	0.08	1.32	Poor
12(1)	117.88	0.97	0.06	0.80	Good	373.96	0.96	0.13	1.34	Poor
12(2)[b]	115.91	0.97	0.06	0.80	Good	217.75	0.98	0.09	0.91	Mixed
Bifactor 12(2)	78.70	0.99	0.05	0.63	Good	104.01	0.99	0.07	0.54	Mixed

Note: IUSC = Intolerance of Uncertainty Scale for Children (Comer et al., 2009); CFI = Comparative Fit Index; RMSEA = Root Mean Square Error of Approximation; WRMR = Weighted Root Mean Square Residual.

[a] 2-factor structure based on Sexton and Dugas (2009), distinguishing "Uncertainty has negative behavioral and self-reference implications" from "Uncertainty is unfair and spoils everything".

[b] 2-factor structure based on Carleton, Norton et al. (2007), distinguishing prospective IU from inhibitory IU.

Sexton & Dugas, 2009) were evaluated in the full 27-item version of the IUSC. Model fit statistics were "mixed" in the child-report models and "poor" in the parent-report models. Next, a 1-factor structure and 2-factor structure (identified in adults by Carleton, Norton et al., 2007) were evaluated in the IUSC-12. Model fit statistics were "good" in the child-report 1-factor IUSC-12 but "poor" in parent-report. Model fit statistics were "good" in the child-report 2-factor IUSC-12 and "mixed" in the parent-report. For the bifactor models, model fit statistics were "good" in the child-report bifactor model, and "mixed" in the parent-report. Reliability indices indicated that for the child-report bifactor model, the general IU factor demonstrated high reliability ($\omega_H = 0.89$), whereas both prospective IU ($\omega_S < 0.001$), and the inhibitory IU subscales did not ($\omega_S = 0.07$); in the child-report model, 88% of the common variance was explained by the general factor (ECV = 0.88). For the parent-report bifactor model, the general IU factor also demonstrated high reliability ($\omega_H = 0.91$), whereas reliability was much lower for the prospective IU ($\omega_S = 0.04$) and the inhibitory IU subscales ($\omega_S = 0.21$); in the parent-report model, 84% of the common variance was explained by the general factor (ECV = 0.84). The bifactor models demonstrated significantly better fit than the 2-factor correlated factors models in the child-report ($\chi^2 = 1113.17$, $p < 0.001$) and parent-report ($\chi^2 = 2338.38$, $p < 0.001$) IUSC-12.

The lengthier version (IUSC; 27 items), demonstrated "poor" to "mixed" fit. Because of this less favorable fit and the preference for parsimonious measures, the IUSC-12 was deemed a preferred measure over the full IUSC. To further elucidate potential dimensionality of IU as measured by the IUSC-12, concurrent validity analyses examined whether the 2 factors (inhibitory and prospective) might yield meaningfully differential associations across anxiety domains (see concurrent validity analyses below).

Table 2 presents factor loadings, means, and SDs for the correlated 2-factor IUSC-12 solution and the bifactor model, by child- and by mother-report for the overall sample (anxious and non-anxious youth). Internal consistency was high for the prospective IU subscale, the inhibitory IU subscale, and total IU (Child-report: $\alpha_{Prospective} = 0.78$; $\alpha_{Inhibitory} = 0.75$, $\alpha_{Total} = 0.86$; Mother-report: $\alpha_{Prospective} = 0.90$; $\alpha_{Inhibitory} = 0.92$, $\alpha_{Total} = 0.94$). Associations between prospective IU and inhibitory IU subscale scores were very high: $r_{child\text{-}report} = 0.74$, $p < 0.001$; $r_{parent\text{-}report} = 0.78$, $p < 0.001$.

3.2. Concurrent validity

Table 3 presents correlations among the prospective IU subscale, inhibitory IU subscale, total IU score, and anxiety symptom domains. Four multivariate general linear models (two for child-report IUSC-12 data and two for parent-report IUSC-12 data) were run to examine relationships between prospective versus inhibitory IU with anxiety symptom domains and total IU with anxiety symptom domains, and findings were interpreted against Bonferroni-corrected alphas of 0.01 (see Table 4). In the first model, child-rated *prospective* IU predicted the MASC child-report harm avoidance subscale, but not the physical symptoms subscale, social anxiety subscale, or separation anxiety subscale. In contrast, child-rated *inhibitory* IU predicted the MASC child-report separation anxiety subscale, but not the social anxiety subscale, physical subscale, or the harm avoidance subscale. Total/general child-reported IU predicted the MASC physical subscale, harm avoidance subscale, social anxiety subscale, and the separation anxiety subscale (see Table 4). In the models evaluating mother-report data, mother-rated *prospective* IU did not predict MASC parent-report physical symptoms, social anxiety, separation anxiety, or harm avoidance (see Table 4). However, mother-rated *inhibitory* IU predicted physical symptoms, social anxiety, and separation anxiety, but not harm avoidance. Total/general mother-reported IU predicted the MASC physical subscale, social anxiety subscale, and the separation anxiety subscale, but not the harm avoidance subscale (see Table 4).

4. Discussion

The present study examined the factor structure of the IUSC in a sample of youth. The present CFA supported a shortened 12-item version of the IUSC (i.e., the IUSC-12, which includes items that are directly parallel to the adult IUS-12). Findings from a correlated factors CFA identified a 2-factor structure of the IUSC-12 that distinguishes apprehensive anxiety/fear regarding future events (i.e., prospective IU) from more present-focused inhibition of behavior due to uncertainty and negative reactions to the presence of uncertainty (i.e., inhibitory IU). Consistent with conceptual and analytic models in the adult literature distinguishing prospective IU from inhibitory IU (e.g., Carleton, Norton et al., 2007; Hong & Lee, 2015; McEvoy & Mahoney, 2011), the present correlated factors CFA found the 2-factor prospective versus inhibitory IU model showed more favorable fit indices in youth than single factor models of IU and a 2-factor model based on Sexton and Dugas' (2009) work distinguishing "uncertainty has negative behavioral and self-reference implications" and "uncertainty is unfair and spoils everything."

While model fit for the 2-factor prospective/inhibitory structure of the shortened IUSC in the overall sample was "mixed" to "good" and factor loadings were high, bifactor models based on recent work by Hale et al. (2016) identified a potential general factor underlying all items. Consistent with Hale et al. (2016), our bifactor CFA models indicated there may be a general factor underlying all items, supporting the IUSC-12 as optimally yielding only one total score. However, whereas Hale et al. (2016) demonstrated a 2-factor correlated factors model had *poor* fit, the 2-factor correlated factors model in the present study's child and adolescent sample had *mixed* fit, indicating that, in contrast to Hale et al.' conclusion that the IUS-12 should not be considered a 2-factor scale, there may be evidence that in youth the prospective/inhibitory model could be a viable way to conceptualize IU and score the IUSC-12. Further, the CFA examining the IUSC-12 as a unidimensional construct showed poor fit in the parent-report data, providing some evidence that scoring the IUSC-12 with one total domain score (at least when using the parent-report IUSC-12) may not be ideal.

Concurrent validity analyses in the present youth sample were largely consistent with much of the adult literature that has found the future-focused prospective IU to be more strongly linked to anxiety disorders characterized by excessive worry and anticipatory apprehension (e.g. GAD, OCD; Hong & Lee, 2015; McEvoy & Mahoney, 2011) and the more present-focused inhibitory IU to be specifically associated with social anxiety (Carleton et al., 2010), panic disorder (Carleton, Sharpe et al., 2007), and depressive disorders (McEvoy & Mahoney, 2012). Similarly, in the present youth sample, inclusive of anxious and non-anxious youth, child-reported prospective IU predicted children's harm avoidance (a subscale of the MASC characterized by excessive worry); both child-reported and mother-reported inhibitory IU predicted separation anxiety; mother-reported inhibitory IU also predicted social anxiety and physical symptoms. Such findings speak to the clinical relevance of the prospective versus inhibitory factor structure of youth IU as measured by the IUSC-12, and speak to seeming continuity in the structure and correlates of IU across the lifespan. Notably, the total IUSC-12 score significantly predicted almost all MASC subscales for both child- and mother-report (with the exception of the relationship between parent-report general IU and the harm avoidance subscale). Although model fit was significantly better in a model demonstrating a general IU factor underlying all items, given findings from the multivariate analysis and previous research, it could be argued that what is gained in slightly improved model fit is lost in differential predictions that may be important in distinguishing anxiety dimensions in youth. However, it is largely unclear based on the present findings what is the most appropriate way to conceptualize IU in youth and use this measure. Despite these mixed findings in regards to the factor structure of the IUSC, the present findings are clearly in support of the

Table 2
Descriptive statistics for the 2-factor IUSC-12 across the full sample.

	Correlated 2-factor Models						Bifactor Models			
	Child Self-Report			Parent-Report			Child Self-Report		Parent-Report	
Item	Factor Loading	*M*	*SD*	Factor Loading	*M*	*SD*	General Factor Loading	Individual Factor Loading	General Factor Loading	Individual Factor Loading
Prospective IU										
7. Surprise events upset me greatly.	0.64	1.98	1.19	0.88	2.36	1.26	0.64	−0.22	0.90	−0.18
8. It frustrates me to not have all of the information I need.	0.66	2.91	1.26	0.84	2.75	1.30	0.66	0.03	0.83	0.08
10. One should always think ahead to avoid surprises.	0.57	2.13	1.15	0.75	2.16	1.15	0.57	0.07	0.73	0.31
11. Plans can be ruined by things you didn't think would happen.	0.49	2.85	1.32	0.84	2.13	1.21	0.49	0.10	0.83	0.06
18. I always want to know what will happen to me in the future.	0.72	2.61	1.41	0.73	2.40	1.27	0.72	0.20	0.70	0.34
19. I don't like being taken by surprise.	0.75	2.06	1.23	0.87	2.14	1.27	0.77	−0.45	0.87	0.03
21. I should be able to prepare for everything in advance.	0.57	2.47	1.29	0.67	1.95	1.12	0.58	0.28	0.62	0.45
Inhibitory IU										
9. Not knowing what could happen keeps me from enjoying life.	0.69	1.83	1.15	0.88	2.06	1.30	0.67	0.18	0.82	0.24
12. When it is time to do things, not knowing what could happen keeps me from acting.	0.66	1.97	1.15	0.85	1.92	1.12	0.63	0.26	0.72	0.50
15. When I am not sure of something I can't work very well.	0.65	2.35	1.17	0.90	2.18	1.23	0.62	0.32	0.79	0.44
20. The smallest doubt can stop me from doing things.	0.72	1.79	1.04	0.87	2.15	1.22	0.68	0.30	0.74	0.51
25. I must get away from all situations where I don't know what will happen.	0.71	1.95	1.19	0.86	2.15	1.89	0.72	−0.06	0.76	0.39

Note: Item numbers above correspond to item numbers on the original IUSC (27-item version; Comer et al., 2009).
Note: The wordings of the items above are from the child self-report IUSC. Items from the parent-report version are directly parallel, with minor word changes to appropriately represent parents reporting on their child (e.g., "I" replaced with "My child…").

Table 3
Correlations among prospective IU subscale and inhibitory IU subscale, and anxiety symptom domains, by informant.

	M (SD)	1	2	3	4	5	6
Child Self-Report Data							
1. Prospective IU Subscale Score	17.29 (5.66)	–					
2. Inhibitory IU Subscale Score	10.07 (4.17)	[c]	–				
3. General IU Total Score	26.88 (9.16)	–	–	–			
4. Harm Avoidance	17.71(4.73)	0.19[*,a]	0.06[b]	0.29[**]	–		
5. Physical Symptoms	10.99(7.03)	0.14[a]	0.23[**,b]	0.42[***]	0.35[***]	–	
6. Social Anxiety	10.20(6.44)	0.04[a]	0.27[**,b]	0.35[***]	0.37[***]	0.51[***]	–
7. Separation Anxiety	8.81(5.07)	0.03[a]	0.18[*,b]	0.29[**]	0.39[***]	0.43[***]	0.37[***]
Parent-Report Data							
1. Prospective IU Subscale Score	15.51(5.94	–					
2. Inhibitory IU Subscale Score	9.98(4.65)	[c]	–				
3. General IU Total Score	26.44 (11.31)	–	–	–			
4. Harm Avoidance	17.61(4.64)	−0.02[a]	0.17[*,b]	0.22[*]	–		
5. Physical Symptoms	6.79(6.19)	0.08[a]	0.20[*,b]	0.33[***]	0.17[*]	–	
6. Social Anxiety	11.97(6.17)	0.04[a]	0.44[***,b]	0.58[***]	0.25[**]	0.46[***]	–
7. Separation Anxiety	9.82(5.98)	0.01[a]	0.25[**,b]	0.44[***]	0.37[***]	0.48[***]	0.42[***]

[a] Value refer to partial correlations controlling for inhibitory IU
[b] Value refers to partial correlations controlling for prospective IU
[c] Partial correlation between prospective IU and inhibitory IU cannot be computed after controlling inhibitory IU.
* < 0.05.
** < 0.01.
*** < 0.001.

IUSC-12, a well-fitting, parsimonious measure of IU in youth demonstrating concurrent validity.

Increasing research with adults suggests IU may be a transdiagnostic factor in the development and treatment of emotional disorders (e.g., Boswell et al., 2013; Carleton, 2016; McEvoy & Erceg-Hurn, 2016). The present findings may suggest that different subcomponents of IU may be differentially associated with different forms of psychopathology. Longitudinal work is needed to consider whether elevated prospective IU places youth at increased risk for future-oriented anxiety problems (e.g., worry, GAD, OCD), whereas elevated inhibitory IU places youth at increased risk for more present-focused, phobic, and/or somatic anxiety problems. Further support for a general factor model of IU in youth over a 2-factor structure would be provided if longitudinal work does not support long-term differential predictive patterns associated with prospective versus inhibitory IU.

Understanding long-term associations can inform prevention and intervention efforts. It is possible that effective treatment for child worry, GAD and/or OCD may be mediated by treatment-related reductions in prospective IU, whereas effective treatment for child physical problems, separation anxiety, and/or social anxiety may be mediated by treatment-related reductions in inhibitory IU. For example, if an adolescent exhibits somatic and phobic problems in the absence of anticipatory worries and apprehension about future events, treatment may do well to target thoughts and behaviors specific to inhibitory IU; conversely, if an adolescent exhibits future-oriented worry in the absence of somatic or phobic problems, treatment may do well to target thoughts and behaviors specific to prospective IU. Given that roughly 40% of anxious youth do not adequately respond to cognitive-behavioral therapy (e.g., James, Soler, & Weatherall, 2005; Walkup et al., 2008), continued efforts are needed to identify other factors that may positively influence anxiety improvement throughout treatment. Perhaps a more tailored focus on relevant subdomains of IU, or IU in general, could help optimize treatment response. The results of this study suggest the IUSC-12 may be a useful tool that can inform tailored

Table 4
Results of multivariate analyses examining concurrent validity.

IUSC-12 Child-Report Scale	Multivariate *F* Statistics Child-Report MASC subscales (n = 78)			
	Harm Avoidance	Physical Symptoms	Social Anxiety	Separation Anxiety
Prospective IU Subscale[a]	6.14[**]	3.86	0.70	0.83
Inhibitory IU Subscale[b]	0.02	4.42	6.00	6.44[**]
Total IU Score	12.25[**]	28.70[**]	18.18[**]	12.36[**]
IUSC-12 Parent-Report Scale	**Multivariate *F* Statistics Parent-Report MASC subscales (n = 123)**			
	Harm Avoidance	Physical Symptoms	Social Anxiety	Separation Anxiety
Prospective IU Subscale[a]	0.03	0.57	0.23	0.12
Inhibitory IU Subscale[b]	4.27	14.21[***]	47.01[***]	20.31[***]
Total IU Score	6.01	14.50[**]	59.78[**]	27.69[**]

** $p < 0.01$.
*** $p < 0.001$.
[a] Prospective and inhibitory IU subscale scores were entered into the same model; values accordingly represent relationships between prospective IU and MASC subscales while controlling for inhibitory IU.
[b] Prospective and inhibitory IU subscale scores were entered into the same model; values accordingly represent relationships between inhibitory IU and MASC subscales while controlling for prospective IU.

treatment efforts.

Although we found child self-reports of prospective IU to be associated with their reports of their harm avoidance, surprisingly we did not find mother-reports of children's prospective or general IU to be associated with mother-reports of children's harm avoidance. Importantly, symptoms of worry are inherently internal phenomena and the prospective IU items are arguably less observable than the inhibitory IU items. Given research suggesting parents of anxious youth disagree more often with their children regarding the presence of internal and unobservable phenomena (e.g., Comer & Kendall, 2004), it is possible that youth are better informants than their parents when it comes to reports of their prospective IU. On the other hand, prospective IU may be a more developmentally sophisticated phenomenon than inhibitory IU, given its reliance on future-oriented cognition and the child's ability to mentally represent future states and hypothetical events. Although we did not find significant associations between child age and prospective or inhibitory IU (all p's > 0.05; results from bivariate correlations not shown), it may be wise for research to further examine the subdomains of child IU in the context of children's cognitive development and abstract future-oriented cognition.

This study is not without limitations. First, only one-quarter of the present sample were from ethnic minority backgrounds. Further, participants at all sites were recruited from urban settings in major metropolitan regions. It is unclear whether these findings would generalize to more ethnically, racially, or geographically diverse populations of youth. Second, given very high rates of comorbidity, this study was not powered to detect potential differences across anxiety disorders in the structure of IU or differential associations between specific anxiety disorders and the two observed IU factors. Third, this study relied exclusively on parent- and child- reports of IU, and did not incorporate behavioral observations. Multimodal examinations that incorporate assessments of children's behavioral performances and decision-making in the context of uncertainty (e.g., Krain et al., 2006, 2008) may prove to be useful complements to assessing IU and its potential subfactors. Fourth, all data were collected at a single time point. Longitudinal research is needed to examine matters of temporal precedence between IU components and anxiety symptom domains, and to inform how the structure of IU may change and influence symptoms across time. Longitudinal work is also needed to consider the continuity of IU structure over time. Future work would do well to also examine etiologic factors associated with the development of IU and its potential sub-components. Recent research documents significant links between maternal and child IU (Sanchez et al., 2016). Although IU may aggregate in families, it is not presently clear whether such familial aggregation is specific to prospective versus inhibitory IU among family members, or whether any form of IU in parents broadly predicts any form of IU in offspring.

Despite these limitations, the present study is the first to examine the factor structure of the IUSC in a sample of youth. These results suggest that there may be multiple structures of IU in children and adolescents, consistent with what has been commonly observed in adults. In addition to studying the structure of IU in youth, this study is further novel in empirically considering the structure of IU in both treatment-seeking and non-anxious participants. Given support in the present sample for the shortened and more efficient IUSC-12 in youth 9 and older, it is hoped that youth anxiety researchers will more systematically incorporate measurement of IU into their evaluations. Such incorporation will better inform our understanding of IU components of children's ability to tolerate uncertainty, and key relationships with child anxiety domains.

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