Evaluating the psychometric properties of the intolerance of uncertainty scale for children in a preadolescent sample

This is the author's final version of the following paper which is published in *Journal of Anxiety Disorders* - https://doi.org/10.1016/j.janxdis.2020.102343

Evaluating the Psychometric Properties of the Intolerance of Uncertainty Scale for Children in a Preadolescent Sample

Nihan Osmanağaoğlu[1, 2], Cathy Creswell[1, 4], Sarah Snuggs[1], Suzannah Stuifzand [1, 3] & Helen F. Dodd[1]

[1]Department of Psychology and Clinical Language Sciences, University of Reading, Reading, UK, RG6 6AL.

[2]Psychological Counselling & Guidance Department, Amasya University, Amasya, Turkey

[3]Lausanne Perinatal Research Group, Lausanne Area, Switzerland

[43]Departments of Experimental Psychology and Psychiatry, University of Oxford, Oxford, UK, OX2 6GG

Correspondence: Helen F. Dodd

School of Psychology and Clinical Language Science,

University of Reading

UK, RG6 6AL

Email: h.f.dodd@reading.ac.uk

Abstract

Intolerance of Uncertainty (IU) is a dispositional tendency to react negatively to uncertainty. The Intolerance of Uncertainty Scale for Children (IUS-C) is designed to measure IU in children but there has been limited investigation into the psychometric properties of this scale. Using data from 227 preadolescent children and 204 parents, we examined (a) readability and whether any items were difficult to understand for children and parents, (b) factor structure, (c) test-retest reliability, and (d) the agreement between child and parent forms of the IUS-C. Results revealed that the reading age of the IUS-C may be too high for preadolescent children and that both children and parents found some items difficult to understand. Model fit with the full IUS-C was not adequate for either parent or child forms. For both forms, selecting items aligned with the IUS-12 led to adequate model fit. For both child-report and parent-report, a one-factor model was supported. Test-retest reliability of total score for all versions was high over a 2-week period (child form: ICC = .82 for 27 item and ICC = .73 for 12 items; parent form: ICC = .87 for 27 item and ICC = .86 for 12 item) but agreement between child and parent forms was consistently poor (r = .24 for 27 item and r=.29 for 12 item). Overall, the results suggest that IUS-C-12 is most appropriate for preadolescent children and their parents. The reading age remains slightly high for preadolescent children so it may be beneficial for future research to consider developing a child-report version with lower reading age.

Keywords: intolerance of uncertainty, child, anxiety, worry, measurement

Introduction

Intolerance of Uncertainty (IU) is "a dispositional characteristic that results from an individual's inability to tolerate the aversive response triggered by the perceived absence of information and the associated uncertainty" (Carleton, 2016 p. 31). Over the last two decades extensive research has focused on the role that IU may play in anxiety disorders, delineating the construct as a transdiagnostic risk factor underlying a broad range of anxiety and mood problems in adults (Carleton, Collimore, & Asmundson, 2010; Counsell et al., 2017; Mathes et al., 2017; Oglesby & Schmidt, 2017; Saulnier et al., 2019, Swee et al., 2019, Tolin, Abramowitz, Brigidi, & Foa, 2003). A recent meta-analysis also revealed a robust association between IU and emotional disorders and symptoms (McEvoy et al., 2019). Given that anxiety disorders often begin during childhood (Kessler et al., 2005), there has been a growing interest in IU in young people. A recent systematic review and meta-analysis revealed a strong positive correlation between IU and both anxiety and worry in children and adolescents (Osmanağaoğlu, Creswell, & Dodd, 2018); however, this review also highlighted the heavy dependence on questionnaire measures, with all 31 studies assessing IU via questionnaire; and the questionnaires used to measure IU in children and adolescents have had limited psychometric evaluation, especially in younger children (Comer et al., 2009; Cornacchio et al., 2017). The present research therefore aims to examine the psychometric properties of the Intolerance of Uncertainty Scale for Children (IUS-C) focusing specifically on preadolescent children.

The Intolerance of Uncertainty Scale (IUS) was the first questionnaire developed to assess IU. It was developed for adults and consists of 27 items on a 5-point Likert-type scale (Freeston, Rhéaume, Letarte, Dugas, & Ladouceur, 1994). The psychometric properties of the scale have been extensively examined; the IUS shows evidence of convergent and divergent

validity, high internal consistency, and good test-retest reliability over a 5-week period (e.g. Sexton & Dugas, 2009; Berenbaum, Bredemeier & Thompson, 2008; Carleton, Norton & Asmudson, 2007, Norton, 2005; Buhr & Dugas, 2002; Freeston et al., 1994). However, initial exploratory factor analysis (EFA) indicated inconsistent factors across studies, high inter-item correlations, and poor factor loadings (Berenbaum, Bredemeier, & Thompson, 2008; Buhr & Dugas, 2002; Freeston et al., 1994; Norton, 2005). Overall, these studies indicated that the IUS should have fewer items and subsequent work tested the stability of a two-factor model using 12 of the original items. The resulting IUS-12 correlated with the original IUS, had high internal consistency and a stable two-factor structure (Carleton, Norton, & Asmundson, 2007). These two factors have been labelled as *Prospective IU*, which refers to desire for predictability, and *Inhibitory IU*, which refers to behavioural inhibition in the presence of uncertainty.

These two factors appear to have clinical relevance; prospective IU has been found to be associated with worry, PTSD, and obsessive-compulsive symptoms, and inhibitory IU has been associated with social anxiety, panic disorder, and depression (Carleton et al., 2010; Mahoney & McEvoy, 2012; McEvoy & Mahoney, 2011, Raines et al., 2019). Nevertheless, recent research has challenged the use of these two subscales because a bifactor structure with a general factor of IU offers better model fit than the correlated two-factor structure (Hale et al., 2016). Hale and colleagues found that the general factor had high reliability and accounted for 80% of the shared variance and concluded that the IUS-12 has a predominantly unidimensional structure. This bifactor model has been supported by other research in adults across clinical and nonclinical samples (Lauriola, Mosca, & Carleton, 2016; Shihata, McEvoy, & Mullan, 2018).

The IUS-C was developed to measure IU in children via child and parent report. It is a downward extension of the original IUS with the items adapted to reduce metacognitive content,

to remove idioms as well as figurative or complex language and to reduce the number of polysyllabic words. Parallel parent and child versions were created from these edited items (Comer et al., 2009). The IUS-C has high internal consistency (α=. 92 for the child report & α=. 96 for the parent report). Convergent and discriminant validity have been demonstrated for the child report form, and to a lesser extent for the parent report form (Comer et al., 2009). The only study to have examined the factor structure of the IUS-C in children and adolescents used confirmatory factor analysis (CFA) using the full set of items on the IUS-C as well as the 12 items that parallel the IUS-12. In this sample aged 9 to 18 years (mean 12.5 years), there was support for both a two-factor structure and a bifactor structure, aligning with the inhibitory and prospective dimensions found in adults (Cornacchio et al., 2017). Although the bifactor structure offered the best model fit, a two-factor structure was also supported and Cornacchio and colleagues argued that the subscales have clinical relevance and should be retained. For the IUS-C, the inhibitory IU (uncertainty paralyses) dimension was associated with social anxiety, separation anxiety, and physical symptoms of anxiety for both child and parent report, consistent with the adult literature. In contrast, the prospective IU (desire for predictability) was only associated with worry when the measures were completed by the child, not when completed by the parent. This may indicate that children are better reporters of their prospective IU than their parents. Prospective IU is more internalised and cognitive in nature than inhibitory IU; therefore, it may be harder for parents to observe and report on it reliably.

Further investigation of the psychometric properties of the IUS-C is warranted for a number of reasons. First, although the items were adapted for children, young children appear to have some difficulty reading and understanding the items (Cowie, Clementi, & Alfano, 2016). Similarly, parents may have difficulty responding to some of the prospective items that ask about

internal states and cognitions. These issues may explain in part why the IUS-C showed poorer utility to distinguish between children with and without anxiety disorders aged 7-8 years relative to children aged 9-15 years (Comer et al., 2009). To our knowledge, no research has assessed the readability or reading age of the items on the IUS-C or explicitly asked children/parents whether they have difficulty understanding and responding to the items. Readability assessment of items in a questionnaire is important because it provides information about whether the items are written at an appropriate level for the target population. Indeed, ensuring that items are written in language that is appropriate for the reading level of the participant is a vital principle when designing questionnaires (Simms, 2008). If participants completing the measure struggle to read the items then this can lead to problems in comprehension and in turn less reliable and valid measurement of the construct in question. Given that previous research has noted anecdotally that children have difficulty understanding the items of the IUS-C (Cowie et al., 2016) this is a particularly important consideration for this scale.

Second, there has been no examination of test-retest reliability of the IUS-C. This is important because IU is conceptualized as a dispositional characteristic and therefore measures of IU should show stability over time. Third, very little is known about the factor structure of IU in preadolescent children. Cornacchio et al. (2017) included participants across a wide age range (9 – 18 years), with a mean age of 12.5 years. Their results are very consistent with those of Boelen, Vrinssen, and van Tulder (2010) who used the adult IUS-12 with 14 to 18 year olds and demonstrated the same two-factor structure. It is therefore possible that the older participants in Cornacchio and colleagues' sample drive the results and it remains to be seen whether this factor structure holds for preadolescent children.

To expand our understanding of IU in preadolescent children, there is a need for research that focuses on the psychometric properties of the IUS-C specifically within this age group. Here we aim to meet this need. We begin by investigating whether there are items that are challenging for children aged 7 to 12 years and their parents to understand and complete and we evaluate the reading age of the IUS-C. Next, we conduct CFA to examine the factor structure of both the child and parent forms. Third, to give a thorough psychometric evaluation, we examined the test-retest reliability, internal consistency, convergent validity with measures of anxiety and worry and parent-child agreement.

Method

Participants

A total of 227 children (115 male) aged between 7.58 and 11.81 (*m*=9.97, *sd*=1.03) were recruited. Of those, 173 children were recruited from two primary schools in the UK and 54 were recruited via public advertising for a larger study examining IU in children. 144 of the children from the primary schools also took part at a second time-point, two-weeks after time 1 (74 male, *m*=10.15, *sd*=0.97).

A total of 204 parents (187 mothers and 17 fathers) of children (102 male) aged between 6.56 and 12.46 (*m*=9.6, *sd*=1.17) were recruited. Of those, 143 parents were recruited through online advertising and took part without their children. 61 parents of participating children took part; 7 were recruited through schools, and 54 were recruited via public advertising. The majority of participants (~80%) were white British, married, from two parent households and had some post-school qualifications. All parents were invited to take part in the study again at time 2 and were sent a link to complete an online questionnaire, 72 (61 mothers and 11 fathers) completed it (their children were 38 male, aged *m*=9.44, *sd*=1.1).

For the subsample where both child and parent data was available (n=61), children were aged between 7.83 and 12.46 years (m=9.52, sd=1.12, 33 female); and 58 parents were mothers. There were no significant differences in the IUS-C scores between this subsample of 61 and the rest of the sample on child report (subsample: n= 61, m= 58.26, sd= 24.61; rest: n=160, m= 58.03, sd= 19, t (219)= .07, p= .94) or parent report (subsample: n= 61, m= 55.03, sd= 23.38; rest: n=143, m= 54.65, sd= 24.6, t (202)= .10, p= .92).

Measures

Intolerance of Uncertainty for Children (IUS-C)-Child & Parent Report (Comer et al., 2009). IU was measured by the IUS-C child and parent-report forms which each have 27 items measured on a 5-point Likert scale (1 = Not at all characteristic of me/my child, 3 = Somewhat characteristic of me/my child, 5 = Entirely characteristic of me/my child). Scores can range from 27 to 135, with higher scores reflecting higher intolerance of uncertainty. The IUS-C was adapted from the adult IU measure (Freeston et al., 1994), for use with children aged 7 to 17 years. For the purpose of this study, a column was added for children and parents to indicate any items that they found difficult to judge. The internal consistencies of the IUS-C in the present sample were excellent for child (α=0.92) and parent report (α=0.97).

Spence Child Anxiety Scale (SCAS) – Child & Parent Report (Spence, 1998). Anxiety symptoms were measured using the child report and parent-report versions of the SCAS. Both measures use a 4-point Likert scale (0 = never, 1 = sometimes, 2 = often, 3 = always). The child report consists of 44 items (38 items related to anxiety symptoms and 6 filler items) and parent report consists of 38 items; higher scores indicate higher anxiety. The SCAS measures have good psychometric properties, including excellent internal consistency (α=0.89 for parent report, α=0.92 for child report), convergent and divergent validity (Nauta et al., 2004; Spence, 1998).

The internal consistencies in the present sample were also excellent (α=0.92 for both child and parent report).

Penn State Worry Questionnaire for Children (PSWQ-C) (Chorpita, Tracey, Brown, Collica, & Barlow, 1997). Worry was measured using the PSWQ-C, which is a 14 item self-report measure on a 4-point Likert Scale (0 = not at all true, 1 = sometime true, 2 = often true, 3 = always true) resulting in a total score ranging from 0-42, with higher scores indicating higher worry. The measure was adapted from the adult Penn-State Worry Questionnaire (Meyer, Miller, Metzger, & Borkovec, 1990), and has demonstrated solid psychometric properties including convergent and discriminative validity, and high internal consistency in clinical and community samples (Chorpita et al., 1997; Pestle, Chorpita, & Schiffman, 2008). The internal consistency of the PSWQ-C in the present sample was excellent (α=0.89).

The Flesh-Kincaid readability test. To evaluate the readability of the IUS-C child and parent forms, the Flesh-Kincaid readability test is used. This test indicates reading ease and grade level of a passage/sentence written in English. The reading ease generates a score between 1 and 100 and higher reading ease score indicates easier readability and higher Flesh-Kincaid Grade Level indicates that the passage/sentence requires higher-grade level. For example, the reading ease score between 90 and 100 indicates 5th grade level, the scores between 80 and 90 indicates 6th grade level, the scores between 70 and 80 indicates grade level of 7th, and so on. Considering the age of participants in this sample, at least 5th grade level and reading ease scores of between 90 and 100 are needed. Other readability assessments are available (e.g. Gunning-Fog Score and Coleman-Liau Index). Analogous to the Flesh-Kincaid readability test, these assessments judge readability using word difficulty and sentence length. Here Fles-Kincaid is chosen as this a

frequently used index of readability which gives information about both grade level and reading ease.

Procedure

All study procedures were conducted with the approval of the University of Reading research ethics committee. Children recruited through schools completed questionnaires during school time. Informed consent was sought from parents prior to the school visit using an opt-out consent procedure. During the school visit, children were informed about the study and their assent was sought. Children were free to withdraw if they wished to. Questionnaires (IUS-C, SCAS, and PSWQ-C) were completed in their classroom under test conditions meaning that they were not allowed to confer with one another or look at each others' responses. Letters were then sent home to parents explaining that their child had taken part that day and inviting parents to take part themselves. Parents who were recruited in this way (n = 7) and through online advertising (n = 143) completed questionnaires (IUS-C, SCAS, and demographics) online. Families who were recruited via local advertisement as a part of a larger study (n = 54) completed the questionnaires whilst attending a lab visit at the University of Reading. Parental consent and child assent was obtained at the time of their visit.

The schools were visited again after two-weeks and the children were asked to complete the IUS-C again (time 2). Similarly, all parents were invited via email to complete the IUS-C again online after two-weeks. A two-week time interval is commonly used to evaluate test-retest reliability (Marx, Menezes, Horovitz, Jones, & Warren, 2003) and was chosen here because it provided a balance between the risk of recollection bias and practicalities of collecting sufficient data at time 2.

Missing/Invalid Data

All 227 children and 204 parents in the original sample at Time 1 attempted to complete the questionnaires. Six children (no parents) were excluded from the main analysis due to incomplete IUS-C forms. In addition, two parents were missing SCAS scores; these cases are removed from analyses involving SCAS scores only. All child and parent data was complete at Time 2.

We checked all variables for univariate outliers (data points ± 3.29 *sd* from the mean). One univariate outlier on the child-report IUS-C was found and excluded from the analysis. The final sample (children) consisted of 220 participants (111 male) aged between 7.58 and 11.81 (*m*=9.97, *sd*=1.04). There were no cases of univariate outliers in the parent data.

Results

Preliminary Analyses

Means and standard deviations for each questionnaire are presented in Table 1. IUS-C scores were not significantly different for males and females for the self-report, t (218) = 1.94, p=. 054 d = 0.26, or parent-report, (t (202) = 0.37, p=. 71, d=0.051) versions of the IUS-C. There were no significant correlations between child age and child-report (r= 0.07, p=. 339), or parent-report (r= -0.05, p=. 496) IUS-C scores.

Readability and Item Difficulty Ratings

The average reading ease score across items was 84.6 for the child measure of IU (IUS-C) indicating approximately 6th grade level (age 11-12 years) and 74.0 for the parent form indicating approximately 7th grade level (age 12-13 years). Table 2 shows the proportion of participants who rated each item as difficult to judge at Time 1. There was a significant, small,

negative correlation between child age and the number of items that were difficult to judge as reported by children; r_s= -0.27, n=220, p< .001 and as reported by parents; r_s= -0.17, n=204, p=0.017. The items most frequently identified as being difficult to understand were as follows: child report, items 1 (18.2), 2 (25%), 16 (19.1%) and 10 (14.1%); parent report, items 1 (17.2%), 2 (29.9%), 10 (15.2%) and 13 (16.7%). The correlations between item reading ease scores and how often the item was selected as difficult to understand were similar in magnitude to the correlations with age above but they was not statistically significant for child (r=-.26, p = .19) or parent (r=.19, p = .331) report forms. Taken together these results indicate that an item being reported as difficult to judge was only marginally determined by the items reading ease and the child's age.

Factor Analysis

For both parent and child report, Confirmatory Factor Analysis using Maximum Likelihood Ratio with Bollen-Stine bootstrapping was conducted in AMOS using Time 1 data. This method of estimation was chosen because the data violated normality assumptions and Bollen-Stine bootstrapping is recommended as an alternative to the Robust Maximum Likelihood approach when using AMOS. In order to conclude that a given model is supported, the Bollen-Stine p value should not be significant (Blunch, 2013, p.241-3).

Sample size is an important consideration in structural equation modelling (SEM); however, there is a lot of variance and uncertainty even in guidelines proposed by SEM researchers. For example, 10 observations (participants) for each estimated (*N:q* ratio) parameter in the model is suggested by Schreiber et al. (2006) yet Bentler & Chou (1987) suggested that the *N:q* ratio can be as low as 5 to 1. On the other hand, Wolf et al. (2013) suggest that a 'one size fits all' approach is not appropriate to determine sample size because there are many

elements that can influence power in SEM (e.g. missing data; latent variables; magnitude of regressive paths). In this case, there were no missing data and the sample size fell into the ratios outlined above.

Guidance suggests that to indicate a model of good fit, the Tucker-Lewis Index (TLI) statistic should be close to 0.90, root mean square error of approximation (RMSEA) values < 0.06 (although some research supports a threshold of 0.07 or 0.08, see Hooper et al., 2008), and comparative fit index (CFI) > 0.95 (Hu & Bentler, 1999, Schreiber et al., 2006). Furthermore, lower AIC and BIC values generally indicate better model fit (Kenny, 2011). For all models evaluated below, the AIC and BIC are shown in Table 5. We compared one- and two-factor solutions for the IUS-C with 27 items and for the IUS-C with 12 items. Following recent research on the IUS-12, we also evaluated a bifactor model that included a general factor as well as the prospective and inhibitory IU factors. Finally, we evaluated whether items that were reported as being difficult to judge affected model fit.

Factor Analysis of the IUS-C Parent Report

Confirmatory factor analysis for the parent report form of IUS-C with 27 items indicated that the model fit for a one-factor solution (χ^2 (324) = 1004.58, $p < .001$, RMSEA = .103, CFI = .84, TLI= .82, BS $p<0.001$) and a two-factor solution (χ^2 (323) = 959.42, $p < .001$, RMSEA = 0.10, CFI = .85, TLI= .84, BS $p<0.001$) were not adequate.

The CFA for the IUS-C with 12 items suggested that a one-factor solution (χ^2 (54) = 162.02, $p < .001$, RMSEA = .10, CFI = .94, TLI= .92, BS $p=0.002$) may not be adequate. The two-factor solution (χ^2 (53) = 110.04, $p < .001$, RMSEA = .07, CFI = .97, TLI= .96, BS p = 0.08) provided better and adequate fit according to the thresholds set above (see Supplementary Table 2 for item loadings). The bifactor model was not supported, producing computational

errors. Following Shihata et al. (2018) we attempted to resolve these issues by removing the prospective IU factor but this did not resolve the computation issues. Because the correlation between the two factors in the parent-report model was very high (.9) we further examined the single-factor model. We identified particularly high modification indices (> 9) for a number of pairs of residuals (15 and 21, 10 and 20, 9 and 18). When we allowed these to correlate, the single factor provided good model fit, $\chi 2$ (51) = 99.01, p < .001, RMSEA = .07, CFI = .97, TLI= .96, BS p=0.151. The item loadings for this final one-factor model is provided in Table 3. For completeness, we also include the factor loadings for the two-factor model in Supplementary Table 1.

Factor Analysis of the IUS-C Child Report

Confirmatory factor analysis for the IUS-C with 27 items indicated that model fit for one-factor solution (χ^2 (324) = 623.13, p < .001, RMSEA = .066, CFI = .85, TLI= .84, BS p = .009) and two-factor solution (χ^2 (323) = 618.76, p < .001, RMSEA = .066, CFI = .85, TLI= .84, BS p = .01) was not adequate.

The CFA for the IUS-C with 12 items suggested that a one-factor solution (χ^2 (54) = 122.75, p < .001, RMSEA = .078, CFI = .88, TLI= .86, BS p = .004) may not be adequate. The two-factor solution (χ^2 (53) = 106.94, p < .001, RMSEA = .07, CFI = .91, TLI= .89, BS p = .018) provided better fit. A bifactor model that included prospective and inhibitory IU factors, $\chi 2$ (42)=79.73, p<0.001, RMSEA=.07, CFI=.94, TLI=.90, BS p = .018, improved model fit further. Following the same procedure as for parent-report, we revisited the one-factor model, allowing pairs of residuals to correlate where modification indices were high (> 9). We identified particularly high modification indices for a number of pairs of residuals (18 and 21, 10 and 20, 10 and 21). When we allowed these to correlate, the single factor provided adequate

model fit, $\chi 2$ (51) = 80.77 , p = 0.005, RMSEA = 0.053 , CFI = 0.95 , TLI= 0.95 , BS p= 0.17, which was superior to the bifactor and two-factor models. The item loadings for this final one-factor model are provided in Table 4. For completeness we also include the loadings for the bifactor model in Supplementary Table 2.

Model fit with item 10 removed

For both parent and child report, the 12-item IUS-C had better model fit than the 27-item version. Of the 12 items on this measure, item 10 had a relatively high proportion of participants stating that it was difficult to judge, in comparison to the other items. We therefore examined whether the fit of the final models above could be improved by removing this item from the 12 item scale.

For child-report, removal of item 10, while allowing residuals to correlate between item pairs with high modification indices, improved the fit of the one-factor model, $\chi 2$ (42) = 49.86 , p = 0.19 , RMSEA = 0.03, CFI = 0.99, TLI= 0.98 , BS p= 0.60. For parent-report, removal of item-10 did not improve the fit of the final one-factor model, $\chi 2$ (43) = 100.80 , p < .001, RMSEA = 0.08, CFI = 0.96, TLI= 0.95, BS p= 0.049.

Test-retest reliability, internal consistency, convergent validity and parent-child agreement

Table 5 shows the results for test-retest reliability, internal consistency, convergent validity and parent-child agreement. To assess test-retest reliability, IUS-C scores from *Time 1* and *Time 2* were examined using intra-class correlations. For convergent validity, Pearson's r correlations were calculated between IUS-C scores and measures of anxiety and worry. Finally, for parent-child agreement, Pearson's r correlations were calculated between parent and child versions of the IUS-C. For each analysis, total score for both parent and child forms of the following versions of the IUS-C were used: (i) the original 27 items on both forms; (ii) the 12

items in the IUSC-12 examined by Cornacchio et al. (2017); (iii) the 11 items scale evaluated above, where item 10 has been removed. The prospective IU and inhibitory IU subscales for the child and parent report 11 and 12 item versions are also included. Analyses for all versions and subscales are reported for completeness and to complement previous research. As shown in Table 5, for all versions of the IUS-C the total score (and subscale score for the parent-report form) indicates good to excellent test-retest reliability, excellent convergent validity with both anxiety and worry and excellent internal consistency. In contrast, all versions indicated poor parent-child agreement. The subscales for parent-report have similarly robust psychometric properties to the total score but, for child-report, the subscale psychometrics are slightly weaker.

Discussion

The IUS-C is designed to measure IU in children and adolescents (7 to 17 years) and is a downward extension of the adult measure of IU (Comer et al., 2009). However, between age 7 and adulthood there is rapid cognitive and metacognitive development that may affect children's processing of and responses to uncertainty. Therefore, here we focused on a relatively narrow age band (7-11 years) to clarify the suitability of the child and parent versions of the IUS-C for preadolescent children.

We first evaluated the suitability of the items for the reading age of the participants and examined whether certain items were difficult to understand. It is recommended that child self-report measures aim for readability that is 2 years below the target minimum age for the measure to ensure that children who are relatively weaker readers can still read the items (Patalay, Hayes, & Wolpert, 2018). Our results therefore indicate that the child report scale might be too challenging for young children given that the reading grade level required was US Grade 6 (age 11-12 years). In contrast, for parent report scales, a reading age of around US Grade 7 is

recommended, which aligns with our assessment of the parent report IUS-C here. In addition to assessing reading ease we asked participants to indicate if any items were difficult to understand. For both the child and parent scales each item was identified as difficult to understand at least once; in general around 5% of participants stated that any given item was difficult to understand. For both scales though, a number of items were more frequently highlighted as difficult to judge. Correlations indicated that reading ease and child age were only marginally correlated with the proportion of participants identifying an item as difficult to judge. This means that the difficulty with responding to these items is not explained by participants' ability to read and understand the item. Instead, it is possible that some of the items may not be appropriate for how IU manifests in younger children or the phrasing of the item may not be clear to participants. The items that were rated as difficult to judge across child and parent-report refer to 'doubt' and feeling 'mixed-up' which may be rather advanced cognitive-emotional constructs for young children and may not therefore be a feature of IU for younger children.

The CFA indicated that, for both forms, the factor structure for the full 27 items was inadequate. For the child-report form, a bifactor model offered reasonable fit for the 12-item measure but the best fit came from the modified one-factor model, which was the only 12-item model of the child-report data that met thresholds for adequate model fit. For the parent-report 12-item version, the bifactor model led to computational errors, the two-factor model offered adequate fit and the best fit came from a modified one-factor model. For both versions, we examined whether the final model could be improved if item 10 was removed. For child-report, this did improve model fit but the parent report model was not improved by the removal of this item. Our conclusion on the basis of these results is that for preadolescent children the 12-item IUS-C is appropriate and that the total score can be used confidently.

The results are somewhat inconsistent regarding the inhibitory and prospective IU subscales. For the child-report form there was support for a one-factor model as well as some support for a bifactor model. This is consistent with the internal consistency, convergent validity and test-retest reliability for the subscales being notably lower than for total score. For child-report therefore, our results align with other recent psychometric evaluations of IU scales in adults which support the use of total score only (Hale et al., 2016; Shihata et al., 2018). For parent-report, there is also support for the use of the total score, with the one-factor model offering the best solution. However, the two-factor solution was also adequate, and the internal consistency, test-retest reliability and convergent validity for these subscales is comparable with the total score, so their use could be justified.

We found good to excellent test-retest reliability over two weeks across all versions of the IUS-C. This supports the idea that IU is a trait that is relatively stable over time and suggests that all versions of the measure are equally reliable with regard to test-rest reliability. In contrast, but consistent with the previous research conducted by Comer et al. (2009), we found poor agreement between child and parent forms across all versions of the IUS-C. One reason for low agreement between child and parent forms may be that some features of IU are unobservable to the parents, meaning that children may be better placed to report on their IU (Comer et al., 2009). Indeed, the items that were most often rated as difficult to judge by parents (items 1, 2, 10, and 13) measure internal concepts related to IU, which are out of parent's direct observation. However, it is also important to acknowledge that discrepancies in parent-child report are a common issue for self-report measures of this nature and that young children may have limited ability to reliably self-report (e.g. Cosi, Canals, Hernández-Martinez, & Vigil-Colet, 2010; March, Parker, Sullivan, Stallings, & Conners, 1997; Miller, Martinez, Shumka, & Baker, 2014).

Further research is needed to better understand the cause of discrepancies between parent and child forms and to make recommendations about who is best placed to report on child IU or how reports from parents and children might be combined. Developing behavioural measures that examine reactions to uncertainty and checking the correlations of various behavioural measures with child and parent-reported IU would also give researchers a better idea regarding different (child or parent) IU reporters. Although there are behavioural measures to examine reactions to uncertainty in adults (e. g. Jacoby et al., 2016), the suitability of such measures for preadolescent children is not yet clear.

Strengths and limitations

This study is the first to provide a thorough psychometric examination of the IUS-C in terms of test-retest reliability and confirmatory factor analysis along with an assessment of reading ease and respondents' perception of the IUS-C items. The sampling and data collection for children and parents were done separately to control for the effect of parental influence on children's responses. We focused on a narrow age band to provide specific insights into the measurement and structure of IU in preadolescent children.

The study has some limitations. First, the sample of parent-child dyads is relatively small but the ICC values suggest that even with a larger sample, good parent-child agreement is unlikely. Similarly, the sample overall is relatively small for factor analysis but the N:p ratio was adequate. Second, most of the children completed the questionnaires in classrooms during school time. They were completed under test conditions (no talking, no looking at each other's' answers) with supervision but it is possible that completing the measures in the presence of others might have affected their responses. This format also meant that we were not able to identify and exclude children with learning difficulties or mental health problems because few

parents provided any information. A final limitation is that for both parent and child report we allowed three pairs of residuals to correlate within the one-factor model based on high modification indices rather than because we had a theoretical reason for doing so. For both measures, the modification indices that were allowed to correlate stood out as being particularly high relative to the others but this procedure means that the CFA was relatively exploratory.

Recommendations for Future Research

Overall our data support the use of a 12-item IUS-C, with parallel child and parent versions. The data highlight that one item in particular (item 10) might be difficult for participants to respond to and removal of this item did improve model fit for the child-report form. However, at this stage it is premature to suggest changes to the measure, given that adequate model fit was achieved with the full 12-item measure. The 12-item measure is strongly recommended over the full 27-item IUS-C because model fit for the fill IUS-C was inadequate and the shortened versions have internal consistency, convergent validity, and test-retest reliability that is comparable to the full version. All versions had poor parent-child agreement and this remains a challenge.

Further examination of the IUS-C factor structure with different and larger samples consisting of a range of narrow age bands would provide insight into how the structure of IU changes with age or remains the same across development. Longitudinal designs to track changes in IU throughout development are also warranted as such work would improve our understanding of whether IU is a fixed trait, as theorised, or whether it waxes and wanes across critical developmental periods (e.g. starting school). One example of such research was conducted by Dugas, Laugesen, and Bukowski (2012) where IU was measured ten times over a 5

year period in a community sample of adolescents and it was observed to descend linearly over time.

Furthermore, while ensuring questionnaire measures of IU in young people are strong is crucial, there is also a need for research that examines IU using behavioural measures and experimental designs. These methods may overcome the issues of self-report. Although self-reports are widely used in psychological research, they are subject to issues such as socially desirable responding and are dependent upon cognitive abilities such as reading level, meta-cognition and understanding as well as insight into emotion. This is particularly an issue for extending IU research to younger children who cannot yet provide reliable self-report. Thus, future work should also consider developing behavioural measures that are appropriate for use across a broad age range to examine IU.

Acknowledgements

We would like to thank all of our participants who generously gave their time as well as Mariel Thottam for assistance with the data collection in the schools and in the lab, and data entry to SPSS, We are also thankful to Charlotte Lewis-Pryde for assistance with the data collection in the lab and data entry to SPSS.

Declaration of interest

NO was supported by a Turkish Government PhD scholarship (ref.537635). HD is supported by an ESRC Future Research Leaders grant ES/L010119/1. CC is supported by an NIHR Research Professorship (RP_2014-04-018).

References

Bentler, P. M., & Chou, C. P. (1987). Practical issues in structural modeling. *Sociological Methods & Research, 16*(1), 78-117.

Berenbaum, H., Bredemeier, K., & Thompson, R. J. (2008). Intolerance of uncertainty: Exploring its dimensionality and associations with need for cognitive closure, psychopathology, and personality. *Journal of Anxiety Disorders, 22*(1), 117-125. doi: http://dx.doi.org/10.1016/j.janxdis.2007.01.004

Birrell, J., Meares, K., Wilkinson, A., & Freeston, M. (2011). Toward a definition of intolerance of uncertainty: A review of factor analytical studies of the Intolerance of Uncertainty Scale. *Clinical Psychology Review, 31*(7), 1198-1208. doi: http://dx.doi.org/10.1016/j.cpr.2011.07.009

Blunch, N.J. (2013). Introduction to Structural Equation Modelling Using IBM SPSS statistics and AMOS. (2nd ed.). London: Sage.

Boelen, P. A., Vrinssen, I., & van Tulder, F. (2010). Intolerance of Uncertainty in Adolescents: Correlations With Worry, Social Anxiety, and Depression. *The Journal of Nervous and Mental Disease, 198*(3), 194-200. doi: 10.1097/NMD.0b013e3181d143de

Buhr, K., & Dugas, M. J. (2002). The intolerance of uncertainty scale: psychometric properties of the English version. *Behaviour Research and Therapy, 40*(8), 931-945. doi: http://dx.doi.org/10.1016/S0005-7967(01)00092-4

Carleton, R. N. (2016). Into the unknown: A review and synthesis of contemporary models involving uncertainty. *Journal of Anxiety Disorders, 39*, 30-43. doi: http://dx.doi.org/10.1016/j.janxdis.2016.02.007

Carleton, R. N., Collimore, K. C., & Asmundson, G. J. G. (2010). "It's not just the judgements—It's that I don't know": Intolerance of uncertainty as a predictor of social anxiety. *Journal of Anxiety Disorders, 24*(2), 189-195. doi: http://dx.doi.org/10.1016/j.janxdis.2009.10.007

Carleton, R. N., Norton, M. A. P. J., & Asmundson, G. J. G. (2007). Fearing the unknown: A short version of the Intolerance of Uncertainty Scale. *Journal of Anxiety Disorders, 21*(1), 105-117. doi: http://dx.doi.org/10.1016/j.janxdis.2006.03.014

Chorpita, B. F., Tracey, S. A., Brown, T. A., Collica, T. J., & Barlow, D. H. (1997). Assessment of worry in children and adolescents: an adaptation of the Penn State Worry Questionnaire. *Behaviour Research and Therapy, 35*(6), 569-581.

Comer, J. S., Roy, A., Furr, J. M., Gotimer, K., Beidas, R. S., Dugas, M. J., & Kendall, P. C. (2009). The Intolerance of Uncertainty Scale for Children: A psychometric evaluation. *Psychological assessment, 21*(3), 402-411. doi: 10.1037/a0016719

Cornacchio, D., Coxe, A. S. S., Roy, A., Pincus, D., Read, K. L., Holaway, R. M., . . . Comer, J. S. (2017). Factor Structure of the Intolerance of Uncertainty Scale for Children. *Journal of Anxiety Disorders*.

Cosi, S., Canals, J., Hernández-Martinez, C., & Vigil-Colet, A. (2010). Parent–child agreement in SCARED and its relationship to anxiety symptoms. *Journal of Anxiety Disorders, 24*(1), 129-133.

Costello, A. B., & Osborne, J. (2005). Best practices in exploratory factor analysis: Four recommendations for getting the most from your analysis. *Practical assessment, research & evaluation, 10*(7), 1.

Counsell, A., Furtado, M., Iorio, C., Anand, L., Canzonieri, A., Fine, A., . . . Katzman, M. A. (2017). Intolerance of uncertainty, social anxiety, and generalized anxiety: Differences by diagnosis and symptoms. *Psychiatry Research, 252*, 63-69. doi: http://dx.doi.org/10.1016/j.psychres.2017.02.046

Cowie, J., Clementi, M. A., & Alfano, C. A. (2016). Examination of the Intolerance of Uncertainty Construct in Youth With Generalized Anxiety Disorder. *Journal of Clinical Child & Adolescent Psychology*, 1-9. doi: 10.1080/15374416.2016.1212358

Dong, Y. & Peng, C. Y. (2013). Principled missing data methods for researchers. *Springerplus,* 2(1), 222.

Dugas, M. J., Laugesen, N., & Bukowski, W. M. (2012). Intolerance of Uncertainty, Fear of Anxiety, and Adolescent Worry. *Journal of abnormal child psychology, 40*(6), 863-870. doi: 10.1007/s10802-012-9611-1

Field, A. P. (2009). *Discovering statistics using SPSS : (and sex and drugs and rock 'n' roll)*. Los Angeles [i.e. Thousand Oaks, Calif.]; London: SAGE Publications.

Freeston, M. H., Rhéaume, J., Letarte, H., Dugas, M. J., & Ladouceur, R. (1994). Why do people worry? *Personality and Individual Differences, 17*(6), 791-802. doi: http://dx.doi.org/10.1016/0191-8869(94)90048-5

Hale, W., Richmond, M., Bennett, J., Berzins, T., Fields, A., Weber, D., ... & Osman, A. (2016). Resolving uncertainty about the Intolerance of Uncertainty Scale–12: Application of modern psychometric strategies. *Journal of personality assessment*, *98*(2), 200-208.

Hooper, D., Coughlan, J. & Mullen, M. R. (2008). Structural Equation Modeling: Guidelines for determining model fit. *Electronic Journal of Business Research Methods,* 6(1), 53-60.

Horn, J. L. (1965). A rationale and test for the number of factors in factor analysis.

Psychometrica, 30(2), 179–185.

Hu, L. & Bentler, P. M. (1999). Cutoff Criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling,* 6(1), 1-55.

Jacoby, R. J., Abramowitz, J. S., Reuman, L. & Blake, S. M. (2016). Enhancing the ecological validity of the Beads Task as a behavioral measure of intolerance of uncertainty. *Journal of Anxiety Disorders,* 41, 43-49.

Kenny, D. A. (2011). Measuring model fit. Retrieved from http://davidakenny.net/cm/fit.htm

Kessler, R. C., Berglund, P., Demler, O., Jin, R., Merikangas, K. R., & Walters, E. E. (2005). Lifetime prevalence and age-of-onset distributions of dsm-iv disorders in the national comorbidity survey replication. *Archives of General Psychiatry, 62*(6), 593-602. doi: 10.1001/archpsyc.62.6.593

Lauriola, M., Mosca, O., & Carleton, R. N. (2016). Hierarchical factor structure of the Intolerance of Uncertainty Scale short form (IUS-12) in the Italian version. Tpm-Testing Psychometrics Methodology in Applied Psychology, 23, 377-394. doi:10.4473/tpm23.3.8

Mahoney, A. E. J., & McEvoy, P. M. (2012). Changes in intolerance of uncertainty during cognitive behavior group therapy for social phobia. *Journal of Behavior Therapy and Experimental Psychiatry, 43*(2), 849-854. doi: http://dx.doi.org/10.1016/j.jbtep.2011.12.004

March, J. S., Parker, J. D., Sullivan, K., Stallings, P., & Conners, C. K. (1997). The Multidimensional Anxiety Scale for Children (MASC): factor structure, reliability, and validity. *Journal of the American Academy of Child & Adolescent Psychiatry, 36*(4), 554-565.

Marx, R.G., Menezes, A., Horovitz, L., Jones, E.C., and Warren, R.F. A comparison of two

time intervals for test-retest reliability of health status instruments. *Journal of Clinical Epidemiology*. 2003; 56: 730–735

Mathes, B. M., Oglesby, M. E., Short, N. A., Portero, A. K., Raines, A. M., & Schmidt, N. B. (2017). An examination of the role of intolerance of distress and uncertainty in hoarding symptoms. *Comprehensive Psychiatry, 72*, 121-129. doi: http://dx.doi.org/10.1016/j.comppsych.2016.10.007

McEvoy, P. M., & Mahoney, A. E. J. (2011). Achieving certainty about the structure of intolerance of uncertainty in a treatment-seeking sample with anxiety and depression. *Journal of Anxiety Disorders, 25*(1), 112-122. doi: http://dx.doi.org/10.1016/j.janxdis.2010.08.010

McEvoy, P. M., Hyett, M. P., Shihata, S., Price, J. E., & Strachan, L. (2019). The impact of methodological and measurement factors on transdiagnostic associations with intolerance of uncertainty: a meta-analysis. *Clinical Psychology Review*, 73, 101778. doi: 10.1016/j.cpr.2019.101778.

Meyer, T. J., Miller, M. L., Metzger, R. L., & Borkovec, T. D. (1990). Development and validation of the penn state worry questionnaire. *Behaviour Research and Therapy, 28*(6), 487-495. doi: http://dx.doi.org/10.1016/0005-7967(90)90135-6

Miller, L. D., Martinez, Y. J., Shumka, E., & Baker, H. (2014). Multiple informant agreement of child, parent, and teacher ratings of child anxiety within community samples. *The Canadian Journal of Psychiatry, 59*(1), 34-39.

Nauta, M. H., Scholing, A., Rapee, R. M., Abbott, M., Spence, S. H., & Waters, A. (2004). A parent-report measure of children's anxiety: psychometric properties and comparison with

child-report in a clinic and normal sample. *Behaviour Research and Therapy, 42*(7), 813-839. doi: 10.1016/s0005-7967(03)00200-6

Norton, P. J. (2005). A psychometric analysis of the Intolerance of Uncertainty Scale among four racial groups. *Journal of Anxiety Disorders, 19*(6), 699-707. doi: http://dx.doi.org/10.1016/j.janxdis.2004.08.002

Oglesby, M. E., & Schmidt, N. B. (2017). The role of threat level and intolerance of uncertainty (IU) in anxiety: An experimental test of IU theory. *Behavior Therapy*. doi: http://dx.doi.org/10.1016/j.beth.2017.01.005

Osmanağaoğlu, N., Creswell, C., & Dodd, H. F. (2018). Intolerance of Uncertainty, anxiety, and worry in children and adolescents: A meta-analysis. *Journal of Affective Disorders, 225*, 80-90. doi: 10.1016/j.jad.2017.07.035

Patalay, P., Hayes, D., & Wolpert, M. (2018). Assessing the readability of the self-reported strengths and difficulties questionnaire. *BJPsych Open, 4,* 44-57. doi: 10.1192/bjo.2017.13

Pestle, S. L., Chorpita, B. F., & Schiffman, J. (2008). Psychometric Properties of the Penn State Worry Questionnaire for Children in a Large Clinical Sample. *Journal of Clinical Child & Adolescent Psychology, 37*(2), 465-471. doi: 10.1080/15374410801955896

Raines, A. M., Oglesby, M. E., Walton, J. L., True, G., & Franklin, C. L. (2019). Intolerance of uncertainty and DSM-5 PTSD symptoms: Associations among a treatment seeking veteran sample. *Journal of Anxiety Disorders,* 62, 61-67.

Saulnier, K. G., Allan, N. P., Raines, A. M. & Schmidt, N. B. (2019). Depression and Intolerance of Uncertainty: Relations between Uncertainty Subfactors and Depression Dimensions. *Psychiatry,* 82:1, 72-79.

Schreiber, J. B., Nora, A., Stage, F. K., Barlow, E. A. & King, J. (2006). Reporting Structural Equation Modeling and Confirmatory Factor Analysis Results: A Review. *The Journal of Educational Research*, 99:6, 323-338.

Sexton, K. A. & Dugas, N. J. (2005). Defining distinct negative beliefs about uncertainty: Validating the factor structure of the Intolerance of Uncertainty Scale. *Psychological Assessment, 21*(2), 176–186. https://doi.org/10.1037/a0015827

Shihata, S. S., McEvoy, P. M., & Mullan, B. A. (2018). A bifactor model of intolerance of uncertainty in undergraduate and clinical samples: Do we need to reconsider the twofactor model? Psychological Assessment, 30 (7), 893-903.

Simms, L.J. (2008). Classical and Modern Methods of Psychological Scale Construction. *Social and Personality Compass (2),* 414-433.

Spence, S. H. (1998). A measure of anxiety symptoms among children. *Behaviour Research and Therapy, 36*(5), 545-566. doi: http://dx.doi.org/10.1016/S0005-7967(98)00034-5

Swee, M. B., Olino, T. M. & Heimberg, R. G. (2019). Worry and anxiety account for unique variance in the relationship between intolerance of uncertainty and depression. *Cognitive Behaviour Therapy,* 48:3, 253-264.

Tolin, D. F., Abramowitz, J. S., Brigidi, B. D., & Foa, E. B. (2003). Intolerance of uncertainty in obsessive-compulsive disorder. *Journal of Anxiety Disorders, 17*(2), 233-242. doi: http://dx.doi.org/10.1016/S0887-6185(02)00182-2

Wolf, E. J., Harrington, K. M., Clark, S. L., & Miller, M. W. (2013). Sample size requirements for structural equation models: An evaluation of power, bias, and solution propriety. *Educational and Psychological Measurement*, *73*(6), 913-934.

TABLE 1: Means & Standard Deviations for the self-report measures

		Total Sample		Male Sample		Female Sample	
		N	***Mean (SD)***	***N***	***Mean (SD)***	***N***	***Mean (SD)***
Child Report	***SCAS***	220	29.65 (16.32)	111	24.60 (15.24)	109	34.79 (15.84)
	PSWQ-C	220	15.78 (8.34)	111	13.98 (8.22)	109	17.62 (8.08)
	IUS-C	220	57.74 (20.02)	111	55.16 (19.33)	109	60.37 (20.45)
Parent Report	***SCAS***	2202	23.64 (14.78)	102	21.97 (14.99)	101	25.32 (14.45)
	IUS-C	204	54.54 (23.97)	102	53.92 (25.75)	101	55.16 (22.14)

SCAS: Spence Child Anxiety Scale; IUS-C: Intolerance of Uncertainty Scale for Children; PSWQ-C; Penn-State Worry Questionnaire for Children

TABLE 2: Proportion of children and parents rating the items as difficult to judge and reading ease scores

Item	% of Children	% of Parents	Reading Ease for Children	Reading Ease for Parents
1. Doubts stop me from having strong opinions.	**18.2**		**66.7%**	
Uncertainty stops my child from having strong opinions.		17.2		40.0%
2. Being unsure means that person is mixed-up.	**25.0**		**66.7%**	
My child believes that being uncertain means one is mixed up.		29.9		87.9%
3. Not knowing what will happen in the future makes life hard.	**10.5**		**87.9%**	
Uncertainty makes my child's life intolerable.		5.9		17.4%
4. It's not fair we can't predict future.	**6.4**		**90.9%**	
My child thinks it's unfair that we can't predict future.		9.3		86.7%
5. I can't relax if I don't know what will happen tomorrow.	**5.5**		**80.3%**	
My child's mind can't be relaxed if he/she doesn't know what will happen tomorrow.		2.5		84.4%

6. Not knowing what will happen in the future makes me uneasy, anxious, or stressed.	**5.9**		**65.7%**	
Uncertainty makes my child uneasy, anxious, or stressed.		1.0		40.0%
7. Surprise events upset me greatly.	**5.5**		**49.4%**	
Unforeseen events upset my child greatly.		0.5		31.5%
8. It frustrates me to not have all of the information I need.	**6.4**		**81.8%**	
It frustrates my child to not to have all the information he/she needs in a situation.		3.9		75.1%
9. Not knowing what could happen keeps me from enjoying life.	**5.5**		**78.2%**	
Uncertainty keeps my child from living a full life.		5.4		75.5%
10. One should always think ahead to avoid surprises.	**14.1**		**61.2%**	
My child believes that one should always look ahead so as to avoid surprises.		15.2		71.7%
11. Plans can be ruined by things you didn't think would happen.	**7.3**		**100%**	
My child believes that a small-unforeseen event can spoil everything, even with the best planning.		6.4		44.9%

12. When it is time to do things, not knowing what could happen keeps me from acting.	**7.3**		**90.1%**	
When it is time to act, uncertainty paralyzes my child.		6.9		61.3%
13. Being unsure of things means that I am not great.	**6.4**		**100%**	
My child believes that being uncertain means that he/she is not first rate.		16.7		89.8%
14. When I am not sure something I can't go forward.	**10.5**		**86.7%**	
When my child is uncertain he/she can't go forward.		5.9		86.7%
15. When I am not sure of something, I can't work very well.	**5.0**		**88.9%**	
When my child is uncertain, he/she can't function very well.		3.9		80.3%
16. Other kids have less doubt than I do.	**19.1**		**100%**	
Other children seem to be more certain than my child.		8.8		86.7%
17. Not knowing what will happen makes me unhappy or sad.	**2.7**		**78.2%**	
Uncertainty makes my child unhappy or sad.		2.5		54.7%
18. I always want to know what will happen to me in the future.	**4.1**		**89.5%**	

My child always wants to know what the future has in store or him/her.		4.4		95.7%
19. I don't like being taken by surprise.	**4.5**		**90.9%**	
My child can't stand being taken by surprise.		1.5		92.9%
20. The smallest doubt can stop me from doing things.	**5.5**		**100%**	
The smallest doubt can stop my child from acting.		2.5		94.3%
21. I should be able to prepare for everything in advance.	**8.6**		**61.3%**	
My child feels as though he/she should be able to organize everything in advance.		4.4		67.5%
22. Being unclear about things means that I am not confident.	**6.4**		**78.2%**	
My child feels as though being uncertain means that he/she lacks confidence.		12.3		83.0%
23. It's not fair that other kids are more sure of things.	**6.8**		**100%**	
My child feels as though it's unfair that other people seem to be sure about their future.		11.3		80.0%
24. Not knowing what can happen keeps me from sleeping well.	**5.0**		**86.7%**	
Uncertainty keeps my child from sleeping soundly.		2.0		54.7%

25. I must get away from all situations where I don't know what will happen.	**8.2**		**83.8%**	
My child tries to get away from all uncertain situations.		4.4		69.7%
26. Things that are unclear stress me.	**4.5**		**100%**	
The ambiguities of life stress my child.		3.4		78.8%
27. I don't like being undecided about the future.	**10.5**		**61.2%**	
My child can't stand being undecided about the future.		2.9		66.1%

Note. Items 7, 8, 9, 10, 11, 12, 15, 18, 19, 20, 21 and 25 comprise the 12-item scale.

Table 3: Factor Loadings for the one factor model IUS-C Parent Report (12 items)

7. Surprise events upset me greatly.	0.81
8. It frustrates me not to have all of the information I need.	0.78
9. Not knowing what could happen keeps me from enjoying life.	0.77
10. One should always think ahead to avoid surprises.	0.71
11. Plans can be ruined by things you did not think would happen.	0.76
12. When it is time to do things, not knowing what could happen keeps me from acting.	0.62
15. When I am not sure of something, I can't work very well.	0.84
18. I always want to know what will happen to me in the future.	0.80
19. I don't like being taken by surprise.	0.78
20. The smallest doubt can stop me from doing things.	0.75
21. I should be able to prepare for everything in advance.	0.75
25. I must get away from all situations where I don't know what will happen.	0.79
Cronbach's α	0.94

Table 4: Factor Loadings for the one factor model IUS-C Child Report (12 items)

7. Surprise events upset me greatly.	0.48
8. It frustrates me not to have all of the information I need.	0.55
9. Not knowing what could happen keeps me from enjoying life.	0.51
10. One should always think ahead to avoid surprises.	0.33

11. Plans can be ruined by things you did not think would happen.	0.56
12. When it is time to do things, not knowing what could happen keeps me from acting.	0.68
15. When I am not sure of something, I can't work very well.	0.68
18. I always want to know what will happen to me in the future.	0.58
19. I don't like being taken by surprise.	0.42
20. The smallest doubt can stop me from doing things.	0.59
21. I should be able to prepare for everything in advance.	0.40
25. I must get away from all situations where I don't know what will happen.	0.64
Cronbach's α	0.83

TABLE 6: AIC & BIC values for all models

	Child		Adult	
	AIC	**BIC**	**AIC**	**BIC**
27 items 1 factor	731.13	912.13	1112.58	1290.69
27 items 2 factors	728.76	913.11	1069.42	1250.82
12 items 1 factor	134.77	225.27	153.01	242.07
12 items 2 factors	156.94	240.74	160.05	242.51
11 items 1 factor	97.86	178.31	146.80	222.66

11 items 2 factors	114.05	191.14	132.44	208.3
12 items bi-factor	151.74	272.4	-	-
11 items bi-factor	108.6	219.21	-	-

TABLE 6: Internal consistencies, SCAS & PSWQ-C correlations of the IUS-C, test-retest reliability, and parent-child agreement

	Score	*IU Version*	*a*	*ICC*	*SCAS (r)*	*PSWQ-C (r)*	*Parent-Child Agreement (r)*
Child Report	*Total Scores*	*27-Items*	0.92	0.82 (95% CI 0.75-0.86)	0.75	0.70	0.24, p=. 07
		12-Items	0.82	0.73 (95% CI 0.66-0.80)	0.70	0.64	0.29, p= .02*
		11-Items	0.82	0.76 (95% CI 0.68-0.82)	0.69	0.64	0.26 , p=.05*
	Subscale Scores	*Inhibitory IU*	0.78	0.63 (95% CI 0.51-0.72)	0.66	0.60	
		Prospective IU	0.71	0.70 (95% CI 0.60-0.77)	0.57	0.54	
		Prospective IU (item 10 omitted)	0.68	0.72 (95% CI 0.63-0.80)	0.60	0.57	
Parent Report	*Total Scores*	*27-Items*	0.97	0.87 (95% CI 0.80-0.92)	0.73	_	0.24, p=. 07
		12-Items	0.94	0.86 (95% CI 0.79-0.91)	0.72	_	0.29, p= .02*

	11-Items	0.94	0.85 (95% CI 0.78-0.91)	0.73	--	0.26 , p=.05*
Subscale Scores	*Inhibitory IU*	0.89	0.85 (95% CI 0.78-0.90)	0.70	_	
	Prospective IU	0.91	0.82 (95% CI 0.73-0.89)	0.68	_	
	Prospective IU (item 10 omitted)	0.91	0.81 (95% CI 0.71-0.88)	0.69	_	

Note. * indicates $p < .05$.
IU = Intolerance of Uncertainty; *a* = Cronbach's alpha; ICC = Intraclass correlation co-efficient; SCAS = Spence Children's Anxiety Scale; PSWQ-C = Penn State Worry Questionnaire for Children.

SUPPLEMENTARY TABLE 1: Factor Loadings for the 2 factor IUS-C Parent Report (12 items)

	Factor 1	Factor 2
7. Surprise events upset me greatly.	0.82	
8. It frustrates me not to have all of the information I need.	0.78	
10. One should always think ahead to avoid surprises.	0.73	
11. Plans can be ruined by things you did not think would happen.	0.76	
18. I always want to know what will happen to me in the future.	0.83	
19. I don't like being taken by surprise.	0.79	
21. I should be able to prepare for everything in advance.	0.78	
9. Not knowing what could happen keeps me from enjoying life.		0.79
12. When it is time to do things, not knowing what could happen keeps me from acting.		0.66
15. When I am not sure of something, I can't work very well.		0.87
20. The smallest doubt can stop me from doing things.		0.79
25. I must get away from all situations where I don't know what will happen.		0.81
Cronbach's α*	0.91	0.88

* Cronbach's α for whole scale = 0.94

SUPPLEMENTARY TABLE 2: Factor Loadings for the bifactor IUS-C Child Report (12 items)

	General factor	Factor 1	Factor 2
7. Surprise events upset me greatly.	0.52	0.19	
8. It frustrates me not to have all of the information I need.	0.59	0.06	
10. One should always think ahead to avoid surprises.	0.41	0.12	
11. Plans can be ruined by things you did not think would happen.	0.58	0.01	
18. I always want to know what will happen to me in the future.	0.65	-0.60	
19. I don't like being taken by surprise.	0.48	0.22	
21. I should be able to prepare for everything in advance.	0.40	-0.27	
9. Not knowing what could happen keeps me from enjoying life.	0.44		0.30
12. When it is time to do things, not knowing what could happen keeps me from acting.	0.57		0.40
15. When I am not sure of something, I can't work very well.	0.58		0.37
20. The smallest doubt can stop me from doing things.	0.46		0.48
25. I must get away from all situations where I don't know what will happen.	0.57		0.30
Coefficient Omega	0.82	0.75	0.74
Coefficient Omega *H*	0.76	0.004	0.27
H	0.81	0.43	0.43
ECV	0.72		
PUC	0.58		