Developing scales measuring disorder-specific intolerance of uncertainty (DSIU): A new perspective on transdiagnostic

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ABSTRACT

Intolerance of uncertainty (IU) is a construct of growing prominence in literature on anxiety disorders and major depressive disorder. Existing measures of IU do not define the uncertainty that respondents perceive as distressing. To address this limitation, we developed eight scales measuring disorder-specific intolerance of uncertainty (DSIU) relating to various anxiety disorders and major depressive disorder. We used exploratory factor analysis and item characteristic curves in two large undergraduate samples (*N*s = 627 and 628) to derive eight three-item DSIU scales (24 items total) that exhibited excellent psychometric properties. Confirmatory factor analysis supported the factor structures of the scales and the transdiagnostic nature of IU. Each scale predicted unique variance in its respective symptom measure beyond a traditional measure of IU. DSIU represents a theoretically proximal and causal intermediary between known vulnerability factors and disorder symptomatology. The DSIU scales can be used to advance theories of psychopathology and inform case conceptualization and treatment planning.

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1. Introduction

Anxiety is inherently defined by a sense of uncertainty because it focuses on an unrealized threat (Barlow, Sauer-Zavala, Carl, Bullis, & Ellard, 2014; Carleton, 2012). Individuals who are threatened by uncertainty may thus face greater susceptibility to experiencing anxiety. This propensity has been referred to as intolerance of uncertainty (IU). A growing body of literature supports IU as underlying or as excabertating symptoms of generalized anxiety disorder (Dugas, Gagnon, Ladouceur, & Freeston, 1998), social anxiety disorder (Carleton, Collimore, & Asmundson, 2010), obsessive–compulsive disorder (Gentes & Ruscio, 2011), health anxiety (Fetzner et al., 2014), posttraumatic stress disorder (Fetzner, Horswill, Boelen, & Carleton, 2013), and panic disorder (Carleton, Fetzner, Hackl, & McEvoy, 2013). Research also supports IU as playing a similar role in major depressive disorder (McEvoy & Mahoney, 2011; Miranda & Mennin, 2007). Early research suggested that IU may be most prominent in generalized anxiety disorder (Dugas, Marchand, & Ladouceur, 2005); but, recent comparative studies suggest levels of IU may be similar across anxiety disorders and major depressive disorder (Boswell, Thompson-Hollands, Farchione, & Barlow, 2013; Carleton, Mulvogue, et al., 2012). The recent findings have led theorists to conclude that IU is not specific to any single disorder, but rather, that it is transdiagnostic and a prominent feature across anxiety disorders and major depressive disorder and potentially a trait-like predisposition to developing these disorders (Carleton, 2012).

Existing research on IU has been made possible by the development of at least six self-report scales designed to measure the construct. The scales differ in content but follow a similar structure. Respondents are presented with a series of statements such as "uncertainty makes life intolerable," "unforeseen events upset me greatly," and "I feel anxious when things are changing," and are

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asked to select a response option from a Likert scale reflecting their endorsement of the statement (e.g., "not at all"). The 27-item Intolerance of Uncertainty Scale (Freeston, Rheaume, Letarte, Dugas, & Ladouceur, 1994) was the first such scale and acted as the primary tool to measure IU prior to the development of a shorter 12-item version named the Intolerance of Uncertainty Scale, Short Form (IUS-12 is the acronym; Carleton, Norton, & Asmundson, 2007). Both the IUS and IUS-12 have exhibited excellent psychometric properties in previous research (Carleton et al., 2007; Dugas et al., 1998; Freeston et al., 1994; Khawaja & Yu, 2010; Norton, 2005). A child form of the IUS has also been developed (Comer et al., 2009). Two similar and longer scales have also been created. The Uncertainty Response Scale (Greco & Roger, 2001) includes 76 items designed to measure coping styles associated with uncertainty. The Intolerance of Uncertainty Index (Carleton, Gosselin, & Asmundson, 2010; Gosselin et al., 2008) includes 72 items designed to measure other dimensions of IU, such as intolerance of the unexpected. The most recent measure of IU is the Intolerance of Uncertainty Scale-Situation-Specific Version, which uses a modified version of the IUS-12 to measure IU in a relatively different fashion (Mahoney & McEvoy, 2011). Respondents are asked to identify a specific situation that they find personally distressing (e.g., going to the supermarket) and rate IUS-12 items while considering uncertainty about that situation (e.g., "uncertainty about this situation keeps me from living a full life").

Existing measures of IU include statements that refer to general uncertainty (e.g., "uncertain situations make me vulnerable"). Respondents are left to interpret uncertainty in their own way. This approach is a strength because the measures can be administered to diagnostically heterogeneous samples; however, this method also precludes the assessment of idiosyncratic features of IU that could guide case formulation and treatment planning. Existing measures help determine whether a person is intolerant of uncertain situations, yet the types of distressing situations and the feared consequences of these situations remain unclear. As a result, specific fears that might need to be targeted in treatment remain unassessed. For example, a person who is primarily intolerant of uncertainty regarding panic sensations may differ in important ways from a person who is primarily intolerant of uncertainty regarding social situations. The Uncertainty Scale-Situation-Specific Version (Mahoney & McEvoy, 2011) partially addresses this limitation by allowing respondents to identify a situation that they find distressing; however, the measure does not specify which uncertain aspects of the situation cause distress and does not shed light on the source of anxiety experienced in the situation. For example, individuals who are concerned about going to a shopping center may vary markedly with respect to what uncertainties they find distressing within that context. Moreover, the Uncertainty Scale-Situation-Specific Version allows identification of only one situation, thereby precluding concurrent examination of IU as it relates to differing concerns.

We suggest that there might be a distinction between non-specific IU, as measured by instruments such as the IUS-12, and IU specific to the various anxiety disorders and major depressive disorder. We refer to this later construct as disorder-specific intolerance of uncertainty (DSIU). The first goal of this study was to develop a series of self-report scales that measure DSIU for generalized anxiety disorder, social anxiety disorder, obsessive–compulsive disorder, health anxiety, posttraumatic stress disorder, panic disorder, specific phobia, and major depressive disorder.[1] To illustrate, the scales could assess IU regarding the

meaning of bodily sensations in panic disorder (e.g., "I'm anxious because I can't be certain when my next panic attack will be") or the possibility of being evaluated negatively by others in the context of social anxiety disorder (e.g., "I get anxious when I'm not sure how a social interaction will turn out"). The scales were developed to expand the scope of existing measures of IU, and to allow clinicians and researchers to identify both the nature and intensity of IU. The scales could be used to guide individualized case formulations and interventions, inform contemporary theories that incorporate IU by increasing the specificity of the construct, and inform future research regarding the role of IU in the development of mental disorders. The second goal of the study was to compare confirmatory factor analytic models in which DSIU items load onto correlated subscales (i.e., a correlated model) or onto uncorrelated subscales and a general factor estimated by all DSIU items (i.e., a bifactor model). Comparing these models would inform the latent structure of the DSIU scales and clarify distinctions between disorder-specific IU and IU that is common across multiple disorders. The third goal of the study was to examine the relative contributions of non-specific IU and DSIU to symptoms of anxiety disorders and major depressive disorder. The third goal would provide an index of criterion validity for the new scales and an initial examination of how the DSIU construct relates to symptoms of different disorders.

2. Methods

2.1. Participants and data collection

Participants were recruited from the undergraduate research pools of the University of Regina and the University of Houston. Data collection for the current study was approved by the University of Regina and the University of Houston research ethics boards. All participants completed the self-report scales in an online Internet survey. Previous results have indicated the order of scales and items that measure anxiety-related constructs does not influence response patterns in Internet surveys (Carleton, Thibodeau, Osborne, & Asmundson, 2012); consequently, all scales were presented as ordered below unless otherwise specified. The survey required approximately 30–45 min to complete. The survey included 12 bogus items that assessed for careless responding (e.g., "sometimes my vision goes all black and white, and that bothers me," "I'm usually quite sure what country I am from" (Meade & Craig, 2012)). Participants were also asked the following question: "We are interested in data from participants who tried to answer honestly and who paid attention when completing the survey. In your honest opinion, should we use your data? Your answer to this question will not affect you in anyway or influence any potential compensation (e.g., bonus points)" (Meade & Craig, 2012). Only data from participants who completed the entire survey without endorsing two or more bogus items, and who reported that their data was reliable, were included. All individuals over the age of 17 who reported being fluent in English were eligible to participate.

In total, 1812 participants started the survey (753 from the University of Regina, 1059 from the University of Houston), 1686 participants completed the survey (718 from the University of Regina, 968 from the University of Houston), and 1548 reported their data would be acceptable for use in the study (699 from the University of Regina, 849 from the University of Houston). Of these, 286 participants (101 from the University of Regina, 185 from the

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[1] This project was conceptualized prior to release of the Diagnostic and Statistical Manual of Mental Disorders, fifth edition (DSM-5, American Psychiatric Association, 2013), which categorized anxiety disorders differently than the DSM-IV. For the

purposes of this project, anxiety disorders as included in the DSM-5, as well as obsessive–compulsive disorder, posttraumatic stress disorder, and health anxiety, are all referred to as anxiety disorders. Health anxiety does not refer to a specific diagnosis, but rather refers to health-based anxiety predominant in individuals with Illness Anxiety Disorder and Somatic Symptom Disorder.

University of Houston) were removed for responding to two or more items designed to assess for careless responding (e.g., agreeing strongly with the statement "I do not understand a word of English"). The final sample comprised 1255 participants (627 from the University of Regina, 628 from the University of Houston).

The mean age of the University of Regina students was 21.27 (SD = 4.89, minimum = 17, maximum = 57) and 78% (n = 282) identified as women. The majority of University of Regina students endorsed having a partial college education (72%) or as completing a 2 or 3 year college diploma/certificate/program (15%). Most participants from the University of Regina reported being single (51%) or being in a relationship but not cohabiting with a partner (26%). A minority reported long-term cohabitation with a partner (8%) or being married (10%) or divorced (2%). The majority of University of Regina students reported being full-time students (83%) and almost half reported being employed part time (48%). Only 5% of the sample reported being employed fulltime. The majority of participants from the University of Regina reported being Caucasian/White (82%), with other reported ethnicities including First Nations [indigenous Canadians] (4%), Black/African American (2%), South Asian (3%), East Asian (4%), and the remaining 5% reported other ethnicities.

The mean age of the University of Houston students was 23.07 (SD = 5.89, minimum = 17, maximum = 61) and 86% (n = 484) identified as women. The majority of University of Houston students endorsed having a partial college education (64%) or as completing a 2 or 3 year college diploma/certificate/program (28%). Most participants from the University of Houston reported being single (47%) or being in a relationship but not cohabiting with a partner (40%). A minority reported long-term cohabitation with a partner (7%) or being married (4%) or divorced (1%). The majority of University of Houston students reported being full-time students (80%) and over a third reported being employed part time (38%). Approximately 9% of the sample reported being employed fulltime. The University of Houston sample was ethnically diverse compared to the University of Regina sample. Approximately 27% of participants reported being Caucasian/White, 29% reported being Hispanic/Latino, 17% reported being Black/African American, 13% reported being South Asian, 6% reported being East Asian, and the remaining 8% reported other ethnicities.

The differences in age between the samples was statistically significant, t = 5.69, p < .001, d = .32. The samples did not include different proportions of women, χ^2 = 0.95, p > .30. Participants from the University of Houston were significantly more likely to identify with an ethnicity that was not Caucasian/White, χ^2 = 377.50, p < .001, relative probability = 4.06.

2.2. Measures

2.2.1. Preliminary DSIU scales

A preliminary list of 137 items was drafted to represent DSIU for generalized anxiety disorder (IU-GAD), social anxiety disorder (IU-SAD), obsessive–compulsive disorder (IU-OCD), health anxiety (IU-HA), posttraumatic stress disorder (IU-PTSD), panic disorder (IU-PD), specific phobia (IU-Phobia) and major depressive disorder (IU-MDD). Items were drafted deductively based on theoretical understanding of the constructs and following reference to materials related to the disorders. The Diagnostic and Statistical Manual of Mental Disorders, fourth edition, text-revision (DSM-IV-TR; American Psychiatric Association, 2000), was utilized as a point of reference for symptoms of each disorder. Measures of constructs that converge with disorders were also utilized as references (e.g., measures of worry for generalized anxiety disorder, anxiety sensitivity for panic disorder, hopelessness for major depressive disorder). Preliminary items were reviewed by all authors. Retained items were agreed upon by all authors as unambiguously reflecting

the role of IU in symptoms. Participants responded to each item by selecting one of the following options reflecting their endorsement of the statement: "0–not at all," "1–a little bit," "2–moderately," "3–quite a bit," "4–extremely."

All scales made use of the header, "Please select the answer that best corresponds to how much you agree with each item." DSIU items for specific phobia were prefaced with additional text to provide context for common fears: "The next series of items are about things or situations that you fear most (e.g., heights, snakes, flying, elevators). Please answer the following questions while keeping in mind what you fear most, even if you are not very fearful of anything." DSIU items for panic disorder followed the symptom measure for panic disorder (Panic Disorder Severity Scale [PDSS]; Houck, Spiegel, Shear, & Rucci, 2002), as it provided relevant definitions for panic attacks and related symptoms. The remaining DSIU scales did not have additional text.

2.2.2. Symptom measures and measure of non-specific IU

The IUS-12 was included as the measure of non-specific IU because it is psychometrically comparable to and shorter than the original Intolerance of Uncertainty Scale (Carleton et al., 2007). Eight separate scales were included to assess diagnostic-specific symptoms for each disorder of interest. Each of the symptom scales has well documented psychometric properties. The measures included the GAD-7 for symptoms of generalized anxiety disorder (Spitzer, Kroenke, Williams, & Lowe, 2006), the Social Interaction Phobia Scale (SIPS) for symptoms of social anxiety disorder (Carleton et al., 2009), the Obsessive–Compulsive Inventory-Revised (OCI-R) for symptoms of obsessive–compulsive disorder (Foa et al., 2002), the Short Health Anxiety Inventory (SHAI) for health anxiety (Salkovskis, Rimes, Warwick, & Clark, 2002), the PTSD Check List–Civilian Version (PCL-C) for symptoms of posttraumatic stress disorder (Weathers, Litz, Huska, & Keane, 1994), the PDSS for symptoms of panic disorder (Houck et al., 2002; Shear et al., 1997), the Phobic Stimuli Response Scales (PSRS) for symptoms of specific phobia (Cutshall & Watson, 2004), and a revised version of the Center for Epidemiologic Studies Depression Scale (CES-D) for symptoms of major depressive disorder (Carleton et al., 2013; Radloff, 1977).

2.3. Analytical strategy

All DSIU items were subject to psychometric analyses. Underperforming DSIU items were discarded following exploratory factor analysis and examination of item characteristic curves. The poorest performing items in each of the analyses were discarded using criteria outlined below. Fit for the proposed factor structures of each of the scales was subsequently tested using confirmatory factor analysis. The first two phases (i.e., exploratory factor analysis and item characteristic curves) were conducted using the Houston sample, while the confirmatory factor analysis was conducted using the Regina sample. This decision was made by coin-toss.

Maximum likelihood exploratory factor analysis with oblique rotation was used to determine the number of factors across all items (Costello & Osborne, 2005). DSIU items were expected to load along eight latent factors, reflecting the eight proposed scales. Parallel analysis was used to determine the number of factors to retain following factor analysis. Parallel analysis involved the calculation of eigenvalues from a correlation matrix that includes randomized values generated by a Monte Carlo method. The eigenvalues resulting from the randomized correlation matrix were compared to those observed in the empirical data. A factor was retained if its eigenvalue was greater than the 95th percentile upper limit confidence interval of its simulated counterpart (Hayton, Allen, & Scarpello, 2004).
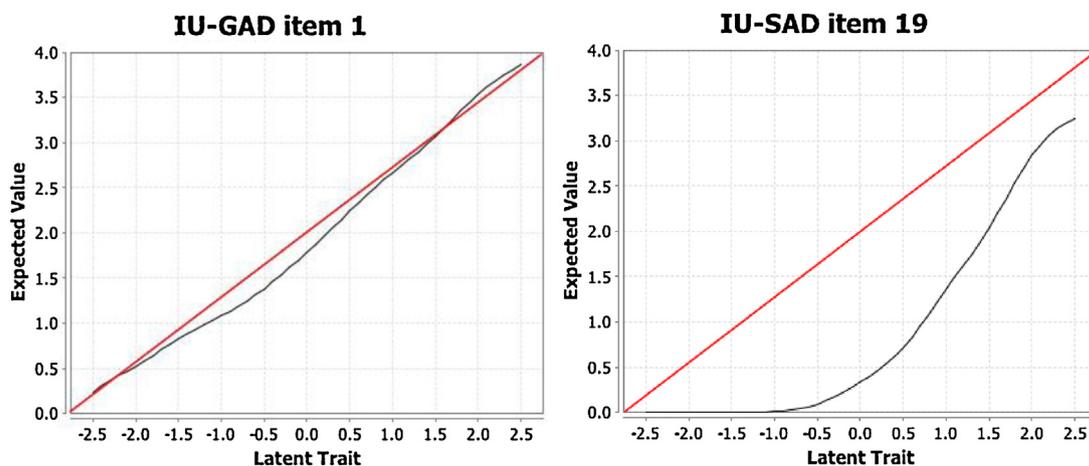
Fig. 1. Values on the Y-axis represent likely response option on the item's five-point scale. Values on the X-axis represent standardized scores of the latent trait of interest (e.g., IU-GAD). IU-GAD item 1 finely discriminates along the entire latent trait, such that any incremental difference on the item represents a difference in the latent trait. IU-SAD item 19 only discriminates well at average levels and higher. The 45° line is plotted for purposes of comparison.

Maximum likelihood factor analysis with oblique rotation was repeated with the number of retained factors specified to reflect the results of parallel analysis. A total of four factor analyses with incrementally more stringent requirements were conducted. Items that did not load at least .30 on a retained factor (Peterson, 2000), or that cross-loaded (i.e., loadings greater than .30 on more than one factor; Tabachnick & Fidell, 2012), were discarded following the first factor analysis. The second factor analysis involved discarding items that did not load .40 onto their respective factor, or that cross-loaded (.30). The third factor analysis involved discarding items that did not load .50 onto their respective factor, or that cross-loaded (.30). The fourth factor analysis involved repeating the discarding of items that did not load .50 onto their respective factor, or that cross-loaded (.30).

Item characteristic curves were plotted as a function of item response theory. The curves plot which response option (e.g., 0, 1, 2, or 3 on a Likert scale) is most likely to be endorsed by an individual with a certain level of a latent trait (Embretson & Reise, 2000). In the present context, item characteristic curves were used to determine how individuals with different levels of a latent trait (e.g., IU-SAD) were likely to endorse a response option on a particular item. For example, an individual with extremely high latent IU regarding social anxiety disorder would be expected to select a high response option on an IU-SAD item; otherwise, that item would be deemed as not measuring the construct adequately. All items from a factor were inputted in an item characteristic curve analysis for each latent factor of interest (e.g., IU-Phobia). An item was deemed as effectively measuring a construct if response options spanned 5–99% of the latent trait. The upper end of the spectrum was given priority (i.e., up to 99th percentile instead of 95th percentile) since the DSIU scales may be applied in populations scoring relatively high on these scales (e.g., clinical populations). Item characteristic curves were rendered using jMetrik 2.1.0 (http://www.itemanalysis.com/).

The exploratory factor analyses and examination of item characteristic curves would result in psychometrically robust scales of varying lengths, referred to as the long draft DSIU scales. Each long draft was shortened by selecting the three items with the highest item-total correlations, resulting in three-item DSIU scales that can be used readily in a variety of settings.

Confirmatory factor analysis was conducted to examine the fit of two competing psychometric models including all three-item DSIU scales. The first model was a correlated factor model that

included eight distinct latent factors estimated using the sets of three items for each of the DSIU scales. All of the latent factors were correlated. The second was a bifactor model that included the same eight distinct latent factors as the correlated model, and also included a general factor that was estimated using all DSIU items. The latent factors did not correlate with each other in the bifactor model.[2] The models were evaluated using the following fit indices and 90 percent confidence intervals (where applicable): (1) Chi-Square (values should not be significant), (2) Chi-Square/df ratio (values should be <3.0 and preferably <2.0), (3) Comparative Fit Index (CFI; values should be greater than .90, and ideal fits approach or are greater than .95), (4) Tucker-Lewis Index (TLI; Tucker & Lewis, 1973 values must be greater than .90, and ideal fits approach or are greater than .95), (5) Standardized Root Mean Square Residual (SRMR; values must be less than .10 and ideal fits approach or are less than .05), and (6) Root Mean Square Error of Approximation (RMSEA; values must be less than .08 and ideal fits approach or are less than .05, with 90% confidence interval values below .10; Browne, & Cudeck, 1993; MacCallum, Browne, & Sugawara, 1996). Evaluations should emphasize the latter five indices (Hu & Bentler, 1999). Confirmatory factor analyses were conducted in Mplus 6.

Lastly, hierarchical linear regression analyses were conducted to test whether the DSIU scales predicted unique variance in their respective symptom measures beyond IUS-12 scores. The first step of the regression analyses included only the IUS-12 as the predictor, and the second step included both the IUS-12 and the relevant DSIU scale for that specific disorder. The regression analyses were also used to determine the simultaneous contributions (β) of DSIU and non-specific IU to symptoms.

3. Results

Parallel analysis supported the retention of eight factors across all DSIU items. Specifically, the derived empirical eigenvalue for the 8th factor (2.51) was greater than its simulated counterpart (1.86) and the derived empirical eigenvalue for the 9th factor (1.50) was less than its simulated counterpart (1.84) and was thus rejected. Items generally loaded within the preconceived factors. Item

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[2] We also considered testing a higher-order model; however, differences in fit between bifactor and higher-order models are often attributable to statistical assumptions rather than appropriateness of the models (Murray & Johnson, 2013).

loadings following the first exploratory factor analysis are available in the supplementary table. The following numbers of items were deleted from each scale for not loading adequately on their respective factors or for cross-loading in the series of exploratory factor analyses: five IU-GAD items, two IU-SAD items, nine IU-OCD items, five IU-HA items, four IU-PTSD items, two IU-PD items, seven IU-Phobia items, and five IU-MDD items.

The item characteristic curve for an item that discriminated incrementally between the 5th and 99th percentile is displayed in Fig. 1 alongside an underperforming item for illustrative purposes. Response options on the underperforming item in Fig. 1 did not discriminate between individuals who scored extremely low on the latent trait from those who scored low or average (i.e., they are most likely to select same response option). All IU-GAD and IU-Phobia items discriminated incrementally along the continuum of their respective latent traits. Seven IU-SAD items, four IU-OCD items, seven IU-HA item, and eight IU-PTSD items were discarded because they did not discriminate incrementally along the continuum of their respective latent traits. All IU-PD items discriminated very poorly at low levels of the latent trait. IU-PD items that discriminated at higher levels of the latent trait were given preference and six items were discarded for not discriminating between the 50th and 99th percentiles. All items on the IU-MDD scale failed to discriminate below the 15th percentile, but all items exhibited similar curves and thus no items were discarded.

The exploratory factor analyses and examination of item characteristic curves resulted in long draft DSIU scales ranging in length from 6 (for IU-OCD and IU-PHOB) to 11 items (for IU-SAD). Each of the long drafts exhibited excellent internal consistency (all αs > .83). The three items with highest item-total correlations were retained (all item-total correlations >.64) to create the final and briefer DSIU scales, which are presented in Table 1. A print-ready document including all scales is available from the first author. Descriptive statistics for the DSIU scales are reported in Table 2. The scales correlated very highly (rs > .91) with their respective long drafts. Item characteristic curves for the final items are included in a supplemental figure. The Regina and Houston samples differed statistically significantly only on the IU-SAD DSIU scale, and the difference was small (Cohen's d = .18).

Fit indices from the confirmatory factor analysis supported excellent fit for the model including correlated DSIU scales (χ^2 = 517.83, df = 224, p < .001; χ^2/df = 2.31; CFI = .98; TLI = .98; SRMR = .04; RMSEA = .04[.04–.05], probability that RMSEA < .05 = 91%). Fit for the bifactor model was marginally superior to the correlated model (χ^2 = 460.19, df = 228, p < .001; χ^2/df = 2.02; CFI = .99; TLI = .98; SRMR = .04; RMSEA = .04[.04–.05], probability that RMSEA < .05 = 99%) and a χ^2 difference tests supported the superiority of the bifactor model (p < .001). The bifactor model was interpreted given that it had better fit and is more parsimonious (i.e., has fewer free parameters). Standardized factor loadings for the bifactor model are presented in Fig. 2. All items loaded greater than .30 onto their respective DSIU scale. Similarly, all items loaded greater than .30 onto the general factor.

The correlations between the DSIU scales are reported in Table 3. All of the scales were statistically significantly correlated in both samples and also correlated with the IUS-12 (ps < .001). The associations between the IUS-12 and the DSIU scales were similar in both samples (all rs between .41 and .57). The results of the hierarchical regressions are reported in Table 4. The proportion of total variance accounted for in the symptom measures by both DSIU and IUS-12 scores varied markedly from 16% for specific phobia symptoms (Regina) to 67% in social anxiety disorder symptoms (both samples). Each of the DSIU scales predicted unique variance in their respective symptom measures beyond the variance attributable to IUS-12 scores (ps < .001). The proportion of unique variance accounted for in the symptom measures by the DSIU scales

Table 1
Disorder-specific intolerance of uncertainty scale items for each of the disorders.

	IU-GAD (generalized anxiety disorder)
1	I worry because I can't be sure about everything
2	I spend too much time worrying about things I can't be certain about
3	I try to control my worry, but it's hard because I can't be sure something bad won't happen
	IU-SAD (social anxiety disorder)
1	I am anxious in social situations because I don't know for sure what people think of me
2	I can't be myself in social situations when I'm not sure whether or not I will be embarrassed
3	I get anxious when I'm not sure how a social interaction will turn out
	IU-OCD (obsessive–compulsive disorder)
1	I often repeat doing things more than necessary in order to be certain
2	I need to work at something until I am sure it is done right
3	When I'm not sure if I did something right, I will do it again until it feels right
	IU-HA (health anxiety)
1	I can't be sure how bad it would be if I had a disease, and that bothers me
2	It bothers me that there is no way to know for sure that I am healthy
3	I worry about catching a disease because I can't be sure that won't happen
	IU-PTSD (posttraumatic stress disorder)
1	I avoid talking about a stressful experience from my past because I'm unsure whether or not it will bother me
2	I avoid thinking about stressful experiences from my past because I'm not sure how it will make me feel
3	I avoid talking about a stressful experience from my past because I can't be certain people will understand
	IU-PD (panic disorder)
1	I'm anxious because I can't be certain when my next panic attack will be
2	It bothers me not knowing what could happen when I have a panic attack
3	I worry when unsure whether or not I will have a panic attack
	IU-Phobia (specific phobia)
1	It is better for me to avoid my fear and be safe than to face it and be unsure of the consequences
2	I get anxious because I can't be certain what would happen if I faced my fear
3	I spend a lot of time making sure I don't need to face my fear
	IU-MDD (major depressive disorder)
1	I feel down because I am unsure how I will cope with my daily life
2	I get upset because I can't know if I will ever feel better about life
3	I feel down because I am uncertain whether or not there is a point to anything

varied from 2% for major depressive disorder symptoms (Regina) to 35% for social anxiety disorder symptoms (Houston). Similarly, the relative simultaneous (β) contributions of DSIU and IUS-12 scores to symptom measures varied markedly. For example, the associations between DSIU scores and symptoms of panic disorder and social anxiety disorder were approximately two to four times greater than the associations between IUS-12 total scores and symptoms of these disorders. In contrast, the relative contributions of DSIU and IUS-12 were similar for symptoms of specific phobia and major depressive disorder, and IUS-12 was the stronger predictor of generalized anxiety disorder and obsessive–compulsive disorder symptoms.

4. Discussion

Existing measures of IU can be used to determine that a person is generally intolerant of uncertainty or intolerant of uncertainty regarding a specific situation; however, those measures were not designed to measure what features of uncertain situations are distressing nor what potential outcomes are anxiety provoking. The newly developed DSIU scales measure IU specifically related to generalized anxiety disorder, social anxiety disorder, obsessive–compulsive disorder, health anxiety, posttraumatic stress disorder, panic disorder, specific phobia, and major

Table 2
Descriptive statistics for the three-item DSIU scales and differences between the samples.

	Regina (n = 627)					Houston (n = 628)					Regina vs. Houston
	Mean	SD	Skew (.10)	Kurtosis (.20)	r with long forms	Mean	SD	Skew (.10)	Kurtosis (.20)	r with long forms	t
IU-GAD	5.03	3.17	.31	−.82	.93	5.22	3.29	.08	−.99	.94	1.04
IU-SAD	3.97	3.19	.66	−.43	.94	3.40	3.21	.87	−.19	.94	−3.15*
IU-OCD	4.90	3.00	.40	−.59	.93	4.80	3.30	.44	−.74	.94	−.58
IU-HA	2.21	2.53	1.42	1.70	.91	2.28	2.90	1.41	1.29	.91	.46
IU-PTSD	3.59	3.36	.72	−.57	.92	3.31	3.47	−.23	−.23	.93	−1.88
IU-PD	.95	2.07	2.76	7.77	.95	.98	2.14	2.74	7.67	.96	.27
IU-PHOB	3.45	2.89	.85	.11	.95	3.34	3.16	.90	.01	.96	−.63
IU-MDD	1.40	2.43	2.38	5.85	.94	1.63	2.73	2.00	3.59	.97	1.59

Notes: All minimum and maximums = 0–12.
* $p < .05$.
Standard error in parentheses; IU, intolerance of uncertainty; GAD, generalized anxiety disorder; SAD, social anxiety disorder; OCD, obsessive–compulsive disorder; HA, health anxiety; PTSD, posttraumatic stress disorder; PD, panic disorder; PHOB, specific phobia; MDD, major depressive disorder.

depressive disorder. Exploratory factor analysis demonstrated that the initial pool of 137 items was best characterized as comprising eight factors that corresponded with the eight disorders of interest. Analyses aimed at discarding underperforming items resulted in long drafts of DSIU scales that were internally consistent. Three-item DSIU scales that predicted a substantive majority of variance of the long draft versions were subsequently identified. We recommend use of the shorter DSIU scales given their large correlations
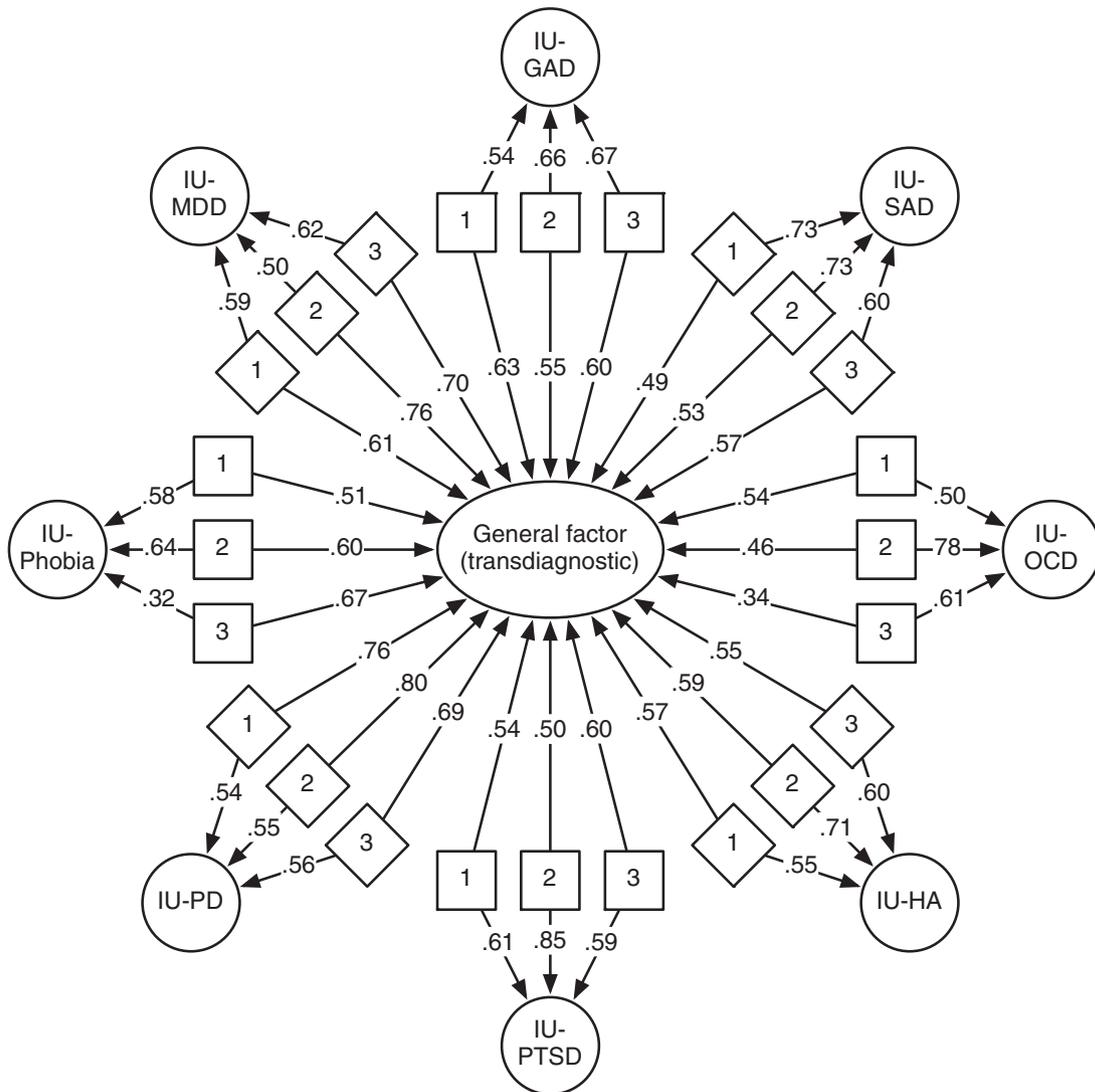

Fig. 2. Results of the confirmatory factor analysis testing the bifactor model. All *ps* < .001; values represent standardized factor loadings; SAD-social anxiety disorder; PD-panic disorder; PTSD-posttraumatic stress disorder; Phobia-specific phobia; HA-health anxiety; MDD-major depressive disorder; GAD-generalized anxiety disorder; OCD-obsessive–compulsive disorder.

Table 3
Correlations between the IUS-12 and the DSIU scales in Houston and Regina samples.

	1	2	3	4	5	6	7	8	9
1. IUS-12	–	.57	.53	.54	.47	.51	.49	.51	.54
2. IU-GAD	.55	–	.49	.47	.37	.41	.36	.45	.41
3. IU-SAD	.41	.32	–	.34	.24	.33	.32	.46	.53
4. IU-OCD	.49	.39	.27	–	.38	.35	.27	.42	.28
5. IU-HA	.45	.40	.25	.40	–	.35	.37	.34	.27
6. IU-PTSD	.44	.32	.32	.29	.30	–	.43	.42	.37
7. IU-PD	.52	.38	.33	.24	.44	.35	–	.43	.45
8. IU-Phobia	.52	.40	.43	.35	.38	.41	.38	–	.44
9. IU-MDD	.51	.39	.42	.22	.34	.38	.56	.39	–

Notes: All ps < .001; values above the diagonal and in italics represent results from the Houston sample; values below the diagonal are from the Regina sample; IUS-12, Intolerance of Uncertainty Scale, Short Form; IU, intolerance of uncertainty; SAD, social anxiety disorder; PD, panic disorder; PTSD, posttraumatic stress disorder; Phobia, specific phobia; HA, health anxiety; MDD, major depressive disorder; GAD, generalized anxiety disorder; OCD, obsessive–compulsive disorder.

Table 4
Relative variance accounted for in symptoms by IUS-12 and the DSIU scales.

DV	Step	Houston					Regina				
		F	R^2	β			F	R^2	β		
				IUS-12	DSIU				IUS-12	DSIU	
GAD (GAD-7)	1	415.04	.39	.63			402.02	.39	.63		
	2	Δ74.01	Δ.07	.45	.31		Δ61.45	Δ.06	.47	.28	
SAD (SIPS)	1	312.87	.33	.58			294.87	.32	.57		
	2	Δ638.10	Δ.34	.21	.68		Δ646.29	Δ.35	.30	.64	
OCD (OCI-R)	1	430.90	.41	.64			408.81	.40	.63		
	2	Δ96.28	Δ.08	.54	.33		Δ67.14	Δ.05	.49	.28	
Health anxiety (SHAI)	1	218.87	.26	.51			191.85	.24	.49		
	2	Δ128.63	Δ.13	.32	.40		Δ255.97	Δ.22	.25	.53	
PTSD (PCL-C)	1	142.18	.19	.63			203.31	.25	.59		
	2	Δ266.41	Δ.24	.39	.47		Δ289.47	Δ.24	.37	.49	
PD (PDSS)	1	415.93	.40	.43			331.44	.35	.50		
	2	Δ232.47	Δ.16	.15	.57		Δ268.95	Δ.19	.20	.57	
Specific phobia (PSRS)	1	95.97	.13	.37			94.81	.13	.37		
	2	Δ28.74	Δ.04	.25	.23		Δ22.86	Δ.03	.26	.20	
MDD (CES-D)	1	157.81	.20	.45			102.40	.14	.38		
	2	Δ17.76	Δ.02	.37	.30		Δ60.48	Δ.08	.26	.42	

Notes: Each regression included the DSIU scale relevant to that disorder (e.g., if SAD is the DV then IU-SAD would a predictor); all ps < .001; DV-dependent variable; IUS-12, Intolerance of Uncertainty Scale, Short Form; SAD, social anxiety disorder; PD, panic disorder; PTSD, posttraumatic stress disorder; MDD, major depressive disorder; GAD, generalized anxiety disorder; OCD, obsessive–compulsive disorder; SIPS, Social Interaction Phobia Scale; OCI-R, Obsessive–Compulsive Inventory-Revised; SHAI, Short Health Anxiety Inventory; PCL-C, PTSD CheckList-Civilian Version; PDSS, Panic Disorder Severity Scale; PSRS, Phobic Stimuli Response Scales; CES-D, Center for Epidemiologic Studies Depression Scale.

with the longer scales and their ease of administration. The long scales are available from the first author upon request.

The associations between the DSIU scales, non-specific IU, and symptom measures were used as indices of criterion validity. Each DSIU scale was strongly associated with non-specific IU, suggesting that the new scales measure a facet of IU. Moreover, each of the DSIU scales predicted unique variance in their respective symptoms beyond non-specific IU, supporting the diagnostic focus of the DSIU scales. The relative associations between DSIU and non-specific IU and symptoms varied markedly across disorders. DSIU predicted symptoms of social anxiety disorder and panic disorder to a greater extent than non-specific IU. In contrast, symptoms of generalized anxiety disorder and obsessive–compulsive disorder were best predicted by non-specific IU, and symptoms of the remaining disorders were predicted similarly by both DSIU and non-specific IU.

The new scales underscore the theoretical distinction between DSIU and non-specific IU, and suggest that the DSIU scales can be used to advance theories regarding the role of IU in anxiety disorders and major depressive disorder. Non-specific IU has been demonstrated as a transdiagnostic factor associated with a variety of disorders (Carleton, 2012; Carleton, Thibodeau, et al., 2012). DSIU, on the other hand, represents a theoretically proximal and explicit causal intermediary between non-specific IU and symptoms of specific disorders. The distinction may warrant elaboration

in theoretical models, and the new scales can be used to test the role of DSIU in these models. For example, the scales could be used to test the causal associations between non-specific IU and DSIU and to determine how these constructs may develop differentially during the lifespan to account for multifinality (i.e., how transdiagnostic risk factors cause multiple disorders) and divergent trajectories (i.e., how individuals with the same transdiagnostic risk factors develop different disorders; Nolen-Hoeksema & Watkins, 2011).

The DSIU scales also have potential clinical utility. The scales could inform what types of uncertain situations are distressing to a client, which could directly inform case conceptualization and treatment planning. For example, DSIU regarding panic symptoms could explain the recurrence of unexpected panic attacks and this form of IU could be targeted directly by using exercises designed to decrease the threat of uncertainty about the potential onset or consequences of unexplained symptoms of arousal. Future research using the DSIU scales could also demonstrate that individuals with different disorders exhibit varying levels of non-specific IU and DSIU. The results of the regression analyses highlight the possibility that certain disorders may be more proximally related to DSIU relative to non-specific IU (e.g., social anxiety disorder, panic disorder). Further support for these findings could suggest that individuals with certain disorders may benefit more from treatments that focus on IU regarding situations closely related to their

symptoms, rather than non-specific IU. To illustrate, a person with social anxiety disorder may benefit from exercises that require him or her to become comfortable with the concept that they can never be certain regarding how others perceive them. In contrast, individuals with other anxiety disorders and major depressive disorder may respond to treatments also focusing on non-specific IU (e.g., Robichaud & Dugas, 2006). The treatments could involve exposure to uncertain situations that vary in relatedness to symptoms (e.g., rolling dice to decide what activity to do, letting someone else order their meal, not reading a drafted email after having written it).

Our use of confirmatory factor analysis supported a bifactor model including eight distinct DSIU scales and a general latent factor estimated by all DSIU items. The model supports that DSIU items are indices of a general factor that explains shared variance between all of the DSIU items. The model also demonstrates that eight distinct latent factors explain additional shared variance amongst identified sets of three items (i.e., the DSIU scales). The nature of this model suggests that associations between the DSIU scales (e.g., correlation between IU-GAD and IU-OCD) are attributable to their strong associations with the general factor. Given that the DSIU items represent IU relating to a variety of disorders, the general latent factor is inherently transdiagnostic; consequently, support for the presence of a general factor estimated by all of these items offers novel evidence for the transdiagnostic nature of IU.

The current study has limitations that offer directions for future research. The most salient limitation was the use of only undergraduate students to develop the DSIU scales. Although some students likely had anxiety disorders and major depressive disorder, the spectrum of symptoms in the current study is mostly circumscribed to the low to high-average range. This limitation is highlighted by the skew and kurtosis values for the DSIU scales. Recruiting undergraduate students was the most feasible option given the large sample needed to derive the scales; however, the psychometric properties of the new scales in clinical samples remain unknown. The newly developed scales, which include a total of 24 items, can be readily administered to clinical samples as a means to further this line of research. Use of clinical samples could also allow estimation of scale norms, and inform whether specific forms of DSIU are common to more than one disorder, which seems particularly relevant given that comorbidity is the norm rather than the exception in clinical samples (Brown, Campbell, Lehman, Grisham, & Mancill, 2001). Future research could also determine whether summing items across the DSIU scales (i.e., summing all 24 items) provides additional utility by estimating global DSIU severity. Researchers could use multiple time-points to estimate test–retest reliability, use treatment samples to inform the treatment sensitivity of the scales, and include other constructs as indices of convergent validity (e.g., distress tolerance, perfectionism).

5. Conclusions

Research on IU has been limited by the use of relatively similar self-report measures that focus on uncertain situations in general. Scales measuring DSIU related to common anxiety disorders and major depressive disorder were developed in this study using two independent samples and the scales exhibited excellent psychometric properties. The brevity of the scales makes them easy to administer individually (three items per scale) or as a cohesive questionnaire (24 items for all eight scales). Our results are unique evidence that IU has both disorder-specific manifestations (i.e., explaining unique variance in specific disorders) and transdiagnostic manifestations (i.e., explaining variance amongst a multitude of disorders). The development of the scales serves as a necessary step for future research aimed at establishing the extent to which DSIU

represents a meaningful and useful construct warranting differentiation from non-specific IU and other vulnerability factors.

Conflict of interest

The authors declare that they have no conflict of interest.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.janxdis.2015.01.006.

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